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Autodesk
Authorized Developer

AutoCAD 2000 - 2013 Compatible

USER MANUAL

3D Surfaces

Unfolding Tool for AutoCAD

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Introduction

The proposed SurfMaster 4 software pack is intended to assist in sheet design construction.

The design uses thin 3D surfaces that can be obtained through the appropriate bending of corresponding planar cutouts.

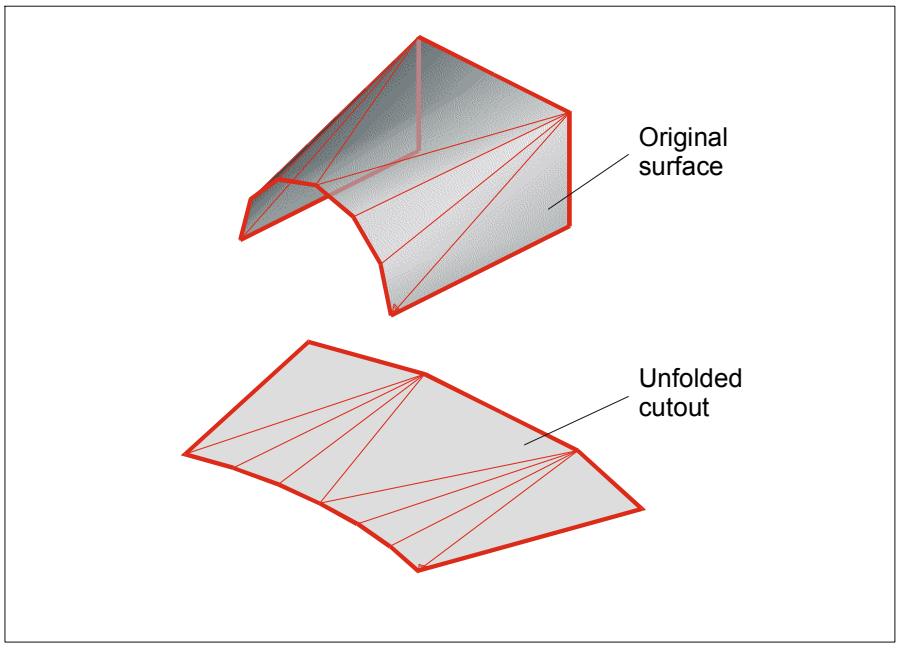

Fig. 1. 3D surface and its flattened cutout

The 3-dimensional surfaces produced in this way have a single concavity because the bending does not cause any volume deformation. These surfaces are also known as “developable surfaces”.

If more complicated 3D surfaces with double concavity should be recreated, they can be approximated with some sequence of segments that are single concavity developable surfaces.

Very often the shapes of a complex object can be represented by definition curves, obtained by intersecting of some set of simple developable surfaces.

As a rule, the object surfaces form something like a skin. The strength of this skin is ensured using certain reinforcing elements. Such elements are cross-sections called “formers”, whose geometry is bound to a given construction.

There are also many linear elements representing details that are also bound to the construction.

Typical sheet design tasks in engineering involve the use of standard parts and solutions that

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are based on some given parameters. This approach is known as a *parametric design* and is ideal for the most common industrial design tasks, where the use of standard elements is preferable if not obligatory.

However, the sets of predetermined design solutions of other software packs are often unable to handle all of the tasks that may be faced in practice. The world around us is large and multifarious and cannot be constrained to a certain set of categories, such as pipes, knees, adapters and toggles.

The main purpose of the SurfMaster pack is to solve such irregular design tasks by using user-defined free-edge developable surfaces. And while the software pack can be used also for processing all standard elements, the adding of the finishing touches – dimensioning and optimal positioning of the produced cutouts, is up to the user.

SurfMaster is not a stand-alone application. The most convenient environment for using SurfMaster is AutoCAD.

It is highly recommended that the user be familiar with the basics of AutoCAD. These include:

- Drawing with precision
- Editing and modifying AutoCAD drawing entities
- Navigating in 3D space

Detailed knowledge of linear objects (i.e., lines, 2D and 3D polylines, splines, circles, ellipses and arcs) is also recommended.

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Basic Concepts

SurfMaster uses 3D wireframe models for representing the design created. Wireframe models consist of definition curves that define the *edges* of surfaces or *segments*. Almost all AutoCAD linear entities (i.e., lines, 3D polylines, 2D normal, splined or fitted polylines, splines, circles, ellipses, circular and elliptical arcs) can be used as definition curves. All of these entities are approximated using 3D polylines that consist of straight segments. Thus, the surfaces can be approximated with the sequence of triangles. To prevent the loss of information during curve approximation, center marks are added to all circles, ellipses, circular and elliptical arcs.

Once decomposed into a sequence of neighboring triangles, the surface can be unfolded triangle by triangle and placed onto the XOY plane of the AutoCAD World Coordinate System. In this way, it is possible to produce a *cutout* which corresponds to its parent surface. Apart from two flattened definition curves, the cutout also contains two linear edges. The first of these edges is considered the cutout's baseline. The baseline and the second line are also drawn between the surface definition curves in 3D space.

Although SurfMaster does not retain any internal information about definition curves, surface cutouts and their definition curves, surface *start marks* are placed both on the surface and on the cutouts making it easy for the user to obtain this information if needed.

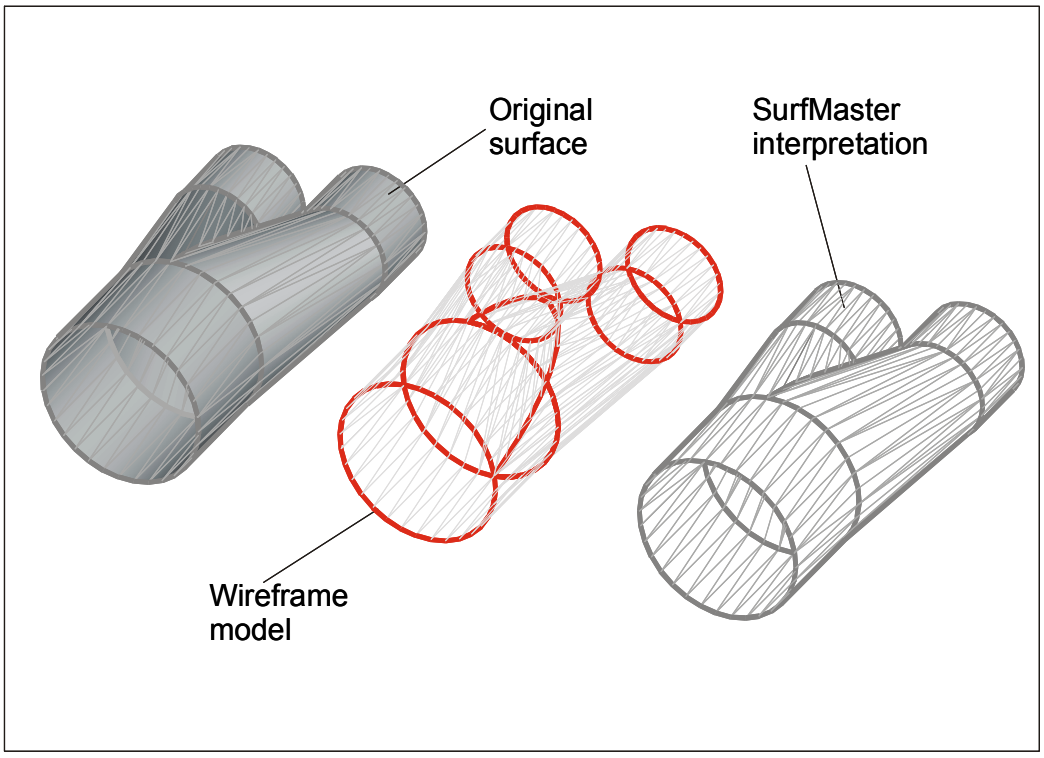

Fig. 2. The actual object, its wireframe model and its SurfMaster interpretation

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It is also interesting to note that SurfMaster does not retain any geometrical information about the surface and its cutout. If such information is required for further processing, such as intersection or folding back, the information is obtained dynamically by recalculating the geometry.

The surface can, of course, be generated as a native AutoCAD polyface mesh entity, which can be also unrolled over the cutout. However, this is used for visualization purposes only.

The decomposition of the 3D surfaces into triangles form the basis for the geometric calculations.

AutoCAD itself has very simple method of decomposition for creating ruled surfaces. It divides the definition curves into an equal number of equidistant straight segments and generates not triangles, but quadrangles. They are convenient only for visualization because their normal vectors needed for calculation of illumination are calculated correctly despite the fact, that quadrangles are not plain objects. If a similar decomposition has to be done but to triangles, the adjacent triangles volume angles will change its sign consecutively and something like a stair effect will appear.

SurfMaster uses more complicated optimization algorithms to produce surfaces with the maximum smoothness possible.

The main triangles decomposing algorithm uses minimum of the integral concavity as criteria and is set as default. The main algorithm for triangular decomposition uses the smallest integral concavity and is set as default. It is great for working with non-twisted surfaces.

For twisted areas, such as those of spiral surfaces, better results can be obtained by using natural optimization, which minimizes the integral deformation of the surface.

In certain cases, the option to use consecutive decomposition without optimization is also provided.

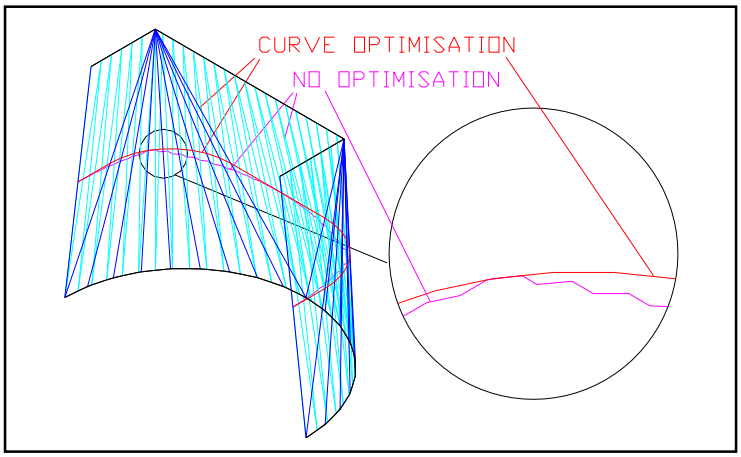

Fig. 3. Curvature optimization mode on/off comparison

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SurfMaster users have the option of three different optimization modes for decomposition. The mode used is displayed as a Roman numeral (I, II or III) within the start marks.

SurfMaster calculates the volume angle between each pair of triangles. If the angle is greater than some preset value, a fold line and fold marks are drawn both in 3D and on the cutouts.

Finally, the decomposition triangles are drawn on a special *sm_control* layer. This allows visual control to be exercised over the results. If the results are acceptable, the control triangles can be deleted using the *clear control (sm_cclear)* command.

If the results differ from those expected, some troubleshooting should be done. This involves: checking and possibly changing the direction of one of the definition curves, splitting the surface into separate adjacent parts and changing the type of decomposition.

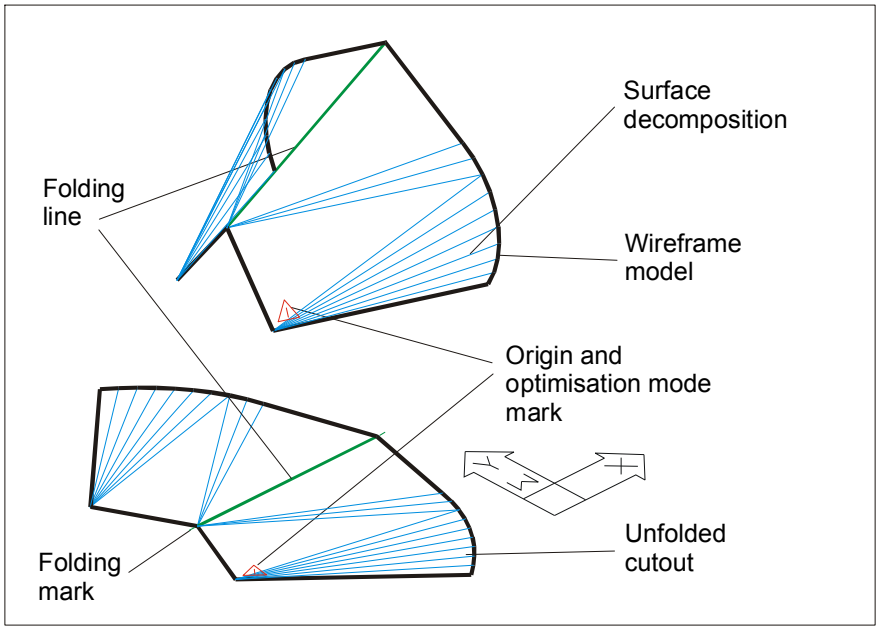

Fig. 4. Using SurfMaster's "Cutout" command to unfold a surface.

Since the 3D surfaces do not have defined front or back sides, their cutouts can appear to be mirrored in the Y direction. Start marks help to keep it more clear.

Once successfully created, the surface/cutout pair can be used in future operations.

Very often, we consider some surfaces as geometric places of an object that we are interested in. We can easily create these objects on the unfolded planar cutouts of these surfaces and then can fold back them on their places in 3D space.

The ***intersect*** command calculates the intersection line(s) between two 3D segments both in 3D space and on their cutouts. Using this command, it is possible to obtain very complicated intersection curves from easy-to-define surfaces. After using the *refine* command, these curves can be used as definition curves for other surfaces.

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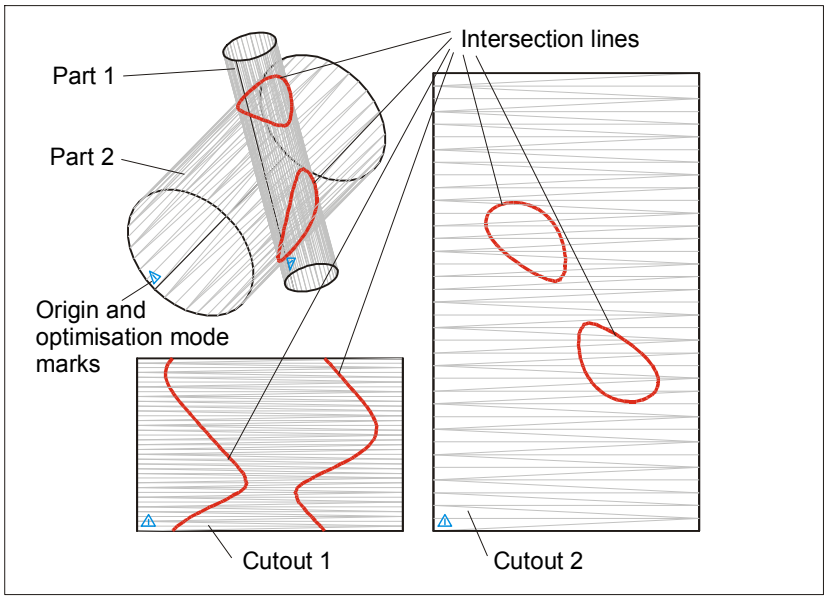

Fig. 5. Using the "intersect" command

SurfMaster also offers the possibility of producing a parallel projection of some set of linear objects on the 3D surface in X, Y or Z direction.

Sometimes it is much easier to draw the necessary objects directly on the cutouts, because only 2D drawing is needed. SurfMaster makes it possible to fold these objects back onto their places on the parent surface in 3D space.

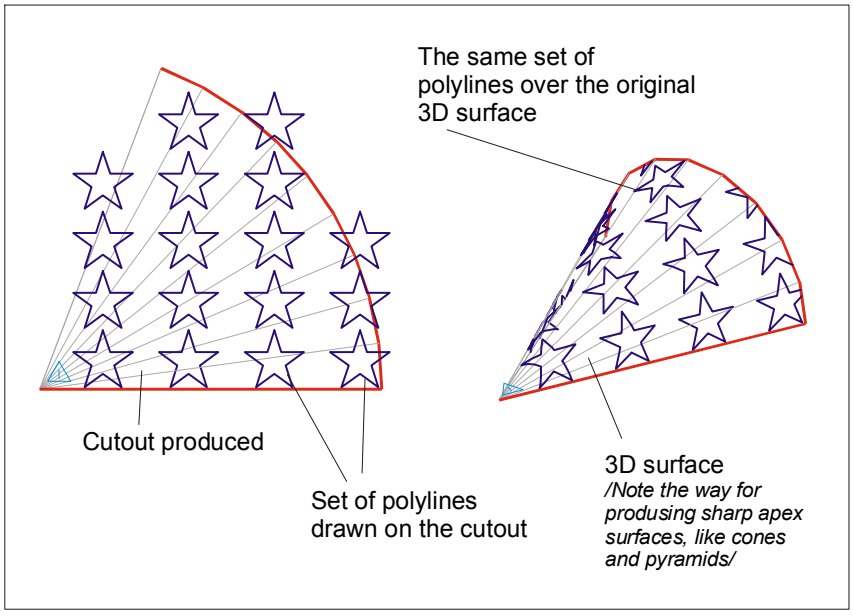

Fig. 6. Drawing polylines directly on the cutout and folding them back over onto the 3D surface

Apart from the basic commands, SurfMaster also provides a set of auxiliary commands, which at can be of help in creating a 3D model and in dealing with definition curves.

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SurfMaster Commands List

Commands for working with segments:

- Unfold /sm_unfold/. This command unfolds the segment and produces its planar cutout.

- Intersect /sm_interx/. This command creates the intersection line(s) between two segments.

-Project planar entities onto a segment / SM_DRAWdir /, where "*dir*" stands for the directions X, Y and Z. The resulting projections are rendered both in 3D and on the cutout.

- Fold back /sm_foldback/. It transfers everything drawn on the cutout back onto the source segment in 3D space.

Commands for working with polyface meshes:

- Create polymesh surface /sm_pfmesh/

- Unroll polymesh /sm_unroll/

- Roll back polymesh /sm_rollback/

- Cut polymesh with closed contour /sm_cutmesh/

Commands for wireframe model construction:

- Create the 3D wireframe model using its parallel projection /sm_construct/

- Extract formers /sm_former/

- 3- or 4-point transformation /sm_transf_c and sm_transf_l/ using container or connecting lines.

- Create container for transformation /sm_container/.

- Create connecting strips /sm_cstripe/

- Add fold marks /sm_fmark/

Commands for dealing with definition curves:

- Convert linear objects to 3D polylines /sm_pln3d/. This command converts lines, arcs, circles, and 2D simple, fitted or splined polylines into 3D polylines in 3D space.

- Convert linear objects to 2D polylines /sm_pln2d/. This command projects all of the above-mentioned entities onto the XOY plane.

- Refine polylines /sm_refine/. This command reduces the number of vertices to the minimum needed for keeping the polyline's shape.

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- Resample polylines /sm_edist/. This command converts a linear drawing object into a 3D polyline with the desired number of vertices. The option to preserve apexes is provided.

- Join linear objects /sm_joinpl/. This command joins segments and produces 3D polylines.

- Reverse order /sm_revord/. Since the order and direction of the internal representation of the edges that define segments are important, this command makes it possible to change them.

- Split contours /sm_split/. This command is useful for setting the origin of the cutout.

- Place the start mark /sm_smark/. This command shows the origin and direction of linear drawing objects.

Auxiliary commands:

- SurfMaster Configuration /sm_config/. This is a tool that helps adjust SurfMaster's configuration settings according to the user's preferences. It can be used to establish how selection sets are created, to select optimization modes and to set certain important parameters for using the SurfMaster software pack.

- Clear Control /sm_cclear/. This command deletes all the triangle sides visualized for controlling the execution of the *unfold* and *intersect* commands. It is highly recommended that the Control mode be on in order to avoid unexpected and unwanted results.

General Notes:

- Strictly follow the order of selecting objects during the command execution. Follow the sequence shown on the command line.

- Use the cutout marks automatically placed at the origin of cutouts and on the 3D surfaces for easy orientation.

- Use the *sm_config* command to set the desired parameters for some of the SurfMaster commands.

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SurfMaster Commands Description

Unfold

SM_UNFOLD

This command unfolds a segment defined by its edges onto a planar cutout. To use it, you should first create the definition curves of the edges represented the surface of the segment.

The definition curves can be one of the following AutoCAD entities:

- lines

- 3D polylines

- 2D polylines containing straight or arc segments

- splined 2D or 3D polylines

- splines

- circles

- ellipses

- arcs (circular or elliptical)

Each of these entities can be used as is or can first be converted to 3D or 2D polylines using the corresponding SurfMaster commands. When converting circles, ellipses and arcs, center marks are automatically added to prevent the loss of information. Splines are refined automatically.

Note that some AutoCAD commands, such as *rectangle* and *polygon,* produce 2D / LW polylines. After being exploded, the *helix* entity appears as a spline.

To obtain a surface's cutout, SurfMaster decomposes the 3D segment into a sequence of triangles and places them on the XOY plane. Three different optimization modes can be used for decomposition:

- Curvature optimization, which uses the minimum of the integral surface's curvature as criteria (I)

- Natural optimization, which uses the smallest potential energy of deformation (II)

- Sequential decomposition without optimization (III)

The first one is recommended and is set as the default.

Since the segment does not have defined front and back sides, the cutout may appear to be mirrored in the Y direction.

The *unfold* command requires a selection set of 2 edges. The order in which they are selected is important. ONLY one entity may be selected at a time.

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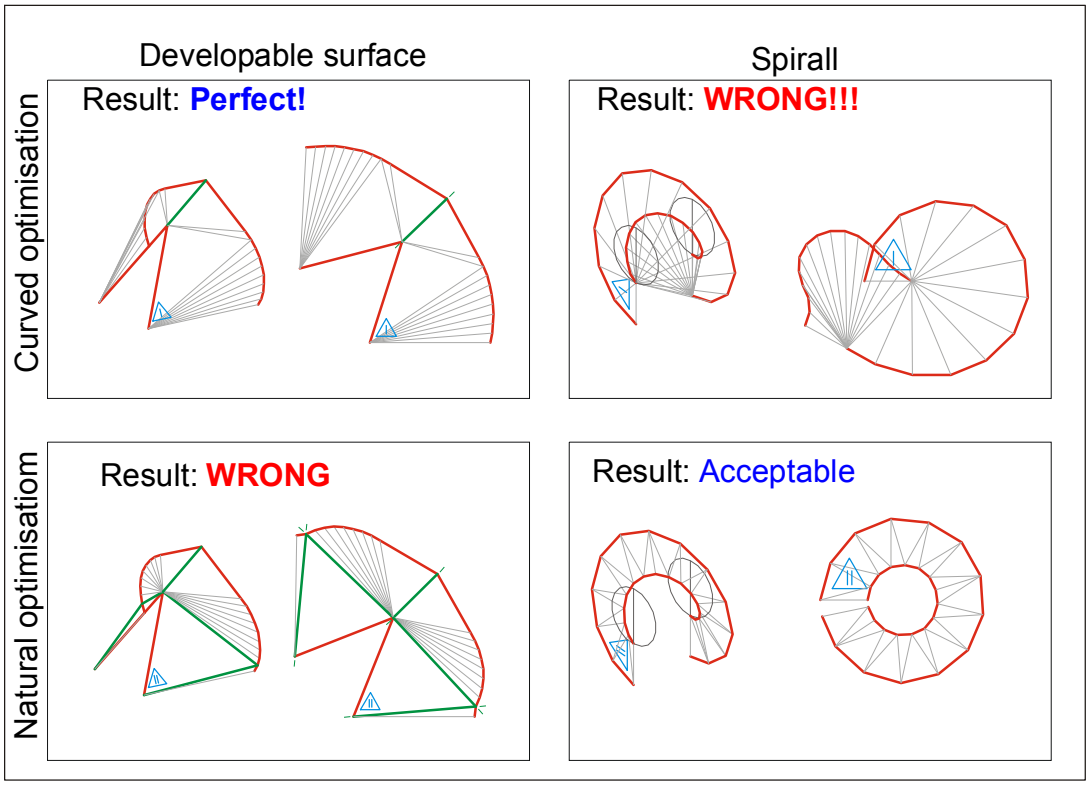

Fig. 7. Comparing the use of optimization modes on different surfaces

To create the selection set:

- Select the 1st definition curve of the surface.

- Select the 2nd definition curve of the surface.

- Press Enter to complete the selection set.

The cutout produced is attached to the cursor and can be dragged to the desired location.

If one of the definition curves is a straight line that touches one of the ends of the other definition curve, the surface is interpreted as being conical.

The first edge selected will be the first edge on the produced cutout. It is recommended that the following sequence be followed for the overall design: from left to right, from front to back, and from bottom to top.

After creating the cutout, SurfMaster attaches it to the cursor. The user can then drag it to the desired position. The decomposition is only illustrated if the control mode is set to ON.

SurfMaster finishes the command by drawing origin marks, fold marks and fold lines.

The origin marks, drawn both on the cutout and for the original surface in 3D space, contain information about the optimization mode used, mirroring, the baseline and the order of the definition curves. This information should be stored in case it is needed later when using other SurfMaster commands, such as the *intersect* command, to work on the same surface and its cutout.

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In the event that the results obtained differ from those expected, the following steps should be taken:

- Check the origin and direction of the definition curves. Use the *sm_revord* command to change their direction if needed, in order to avoid a basket effect.

- If the direction of the curves is correct, yet the result is still not as was expected, split the curve into two or more parts using the *sm_split* command.

- If neither of the previous steps help /in the case of spiral surfaces /, change the optimization mode to natural using the *sm_config* command.

Be sure that the appropriate values of the parameters affecting command execution are properly set using the *sm_config* command.

The control triangles' decomposition lines can be removed using the *sm_cclear* command.

Intersect

SM_INTERX

This command creates an intersection line(s) between two segments, defined by their edges, and provides the option to have this line drawn on one or on both of their cutouts.

The settings and the order should be exactly the same as those used for the segments' cutouts if they have already been created with the *unfold* command. The optimization mode, baseline and the order of the definition can be obtained from the *origin marks*.

Below is an illustration of the process of triangular decomposition when the control mode is ON.

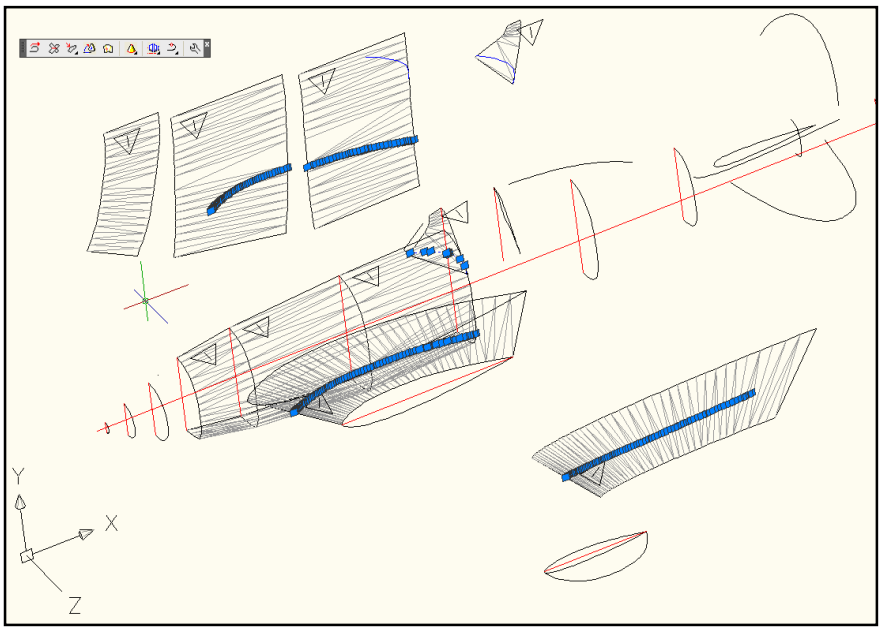

Fig. 8. Obtaining the intersection lines between surfaces

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The *intersect* command requires a selection set of two segments and, optionally, one or two corresponding cutouts. The selection set, therefore, consists of two types of entities: required and optional. ONLY one entity may be selected.

To create the selection set:

- Select the 1st curve of the 1st surface.

- Select the 2nd curve of the 1st surface.

- Select the 1st curve of the 2nd surface.

- Select the 2nd curve of the 2nd surface.

- Select the baseline of the 1st cutout (optional).

- Select the baseline of the 2nd cutout (optional).

- Press Enter to complete the selection set.

You can remove the decomposition lines of the control triangles using the *sm_cclear* command.

It is highly recommended that the *sm_refine* command be used to reduce the number of vertices in the resulting curves.

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Draw in direction X, Y or Z

SM_DRAWX

SM_DRAWY

SM_DRAWZ

These commands are similar and create a linear projection of the selected entities onto a surface defined by its curves. The obtained intersection lines are drawn on the surface in 3D space and, optionally, on its cutout.

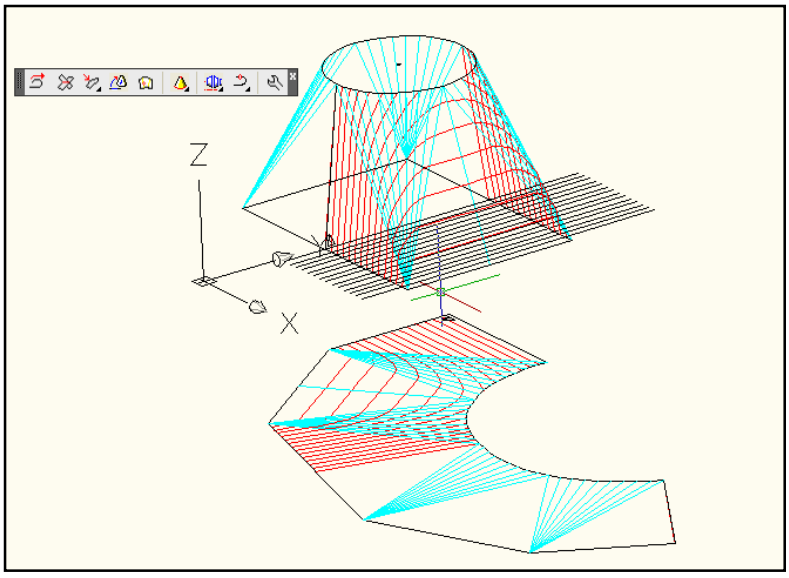

Fig. 9. Drawing in direction Z

The settings and the order should be exactly the same as those used for the segments' cutouts if they have already been created with the *unfold* command. The optimization mode, baseline and the order of the definition curves can be obtained from the *origin marks*.

Each of the commands requires two selection sets. The first set includes the surface's definition curves and, optionally, the surface's cutout base. The other one includes the entities to be projected. ONLY one entity may be selected at a time for the first selection set.

To create the selection sets:

- Select the 1st curve.

- Select the 2nd curve.

- Select the baseline of the cutout (optional).

- Press Enter to complete the first selection set.

- Select the entities to be projected.

- Press Enter to complete the second selection set.

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You can remove the decomposition lines of the control triangles using the *sm_cclear* command.

Fold back

SM_FOLDBACK

This command takes the entities drawn on the cutout created using the *unfold* command and folds them back onto the parent segment.

Be sure to **use the same settings and order as the ones used during the generation of the cutout**.

The optimization mode, baseline, mirroring and the order of the definition curves can be obtained from the origin marks.

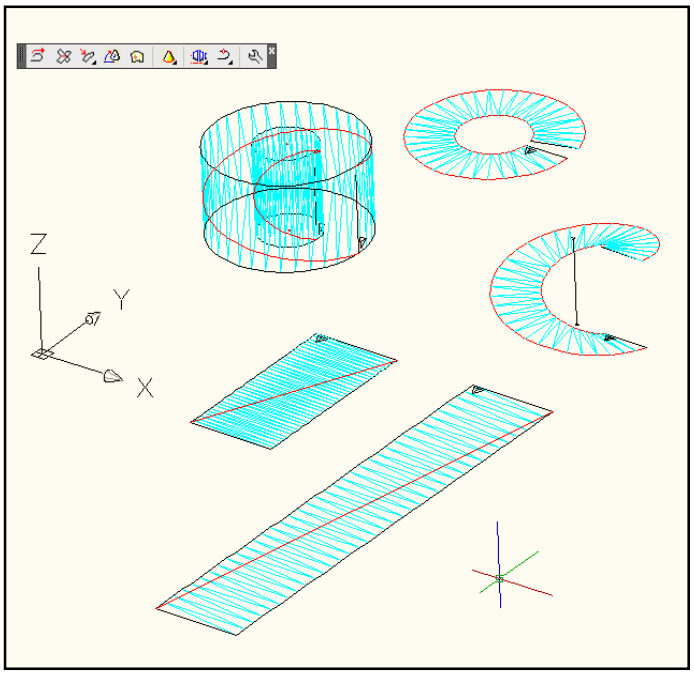

Fig. 10. Using the "fold back" command to create a spiral surface

The *fold back* command requires a selection set composed of the definition curves, the cutout base and the entities drawn on the cutout that is to be folded back into 3D. ONLY one entity may be selected at a time.

To create the selection set:

- Select the 1st curve of the parent surface.

- Select the 2nd curve of the parent surface.

- Select the baseline of the cutout.

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- Select the entities that should be folded back.

- Press Enter to complete the selection set.

If the unfolded entities are closed contours, the origin of the resulting contours may differ.

Clear control

SM_CCLEAR

This command permanently deletes all entities in the *sm_control* layer which were created using SurfMaster commands

Draw polyface mesh

SM_PFMESH

This command creates a polyface mesh representing a surface, defined by its definition curve. The polyface mesh is used for visualization purposes only. It can be unrolled onto the surface's cutout, cut by some closed contour and rolled back.

If you have already used this surface, be sure to **use the same settings and order as those in the previous step**.

The *draw polyface mesh* command requires a selection set of 2 edges. The order in which they are selected is important. . ONLY one entity may be selected at a time.

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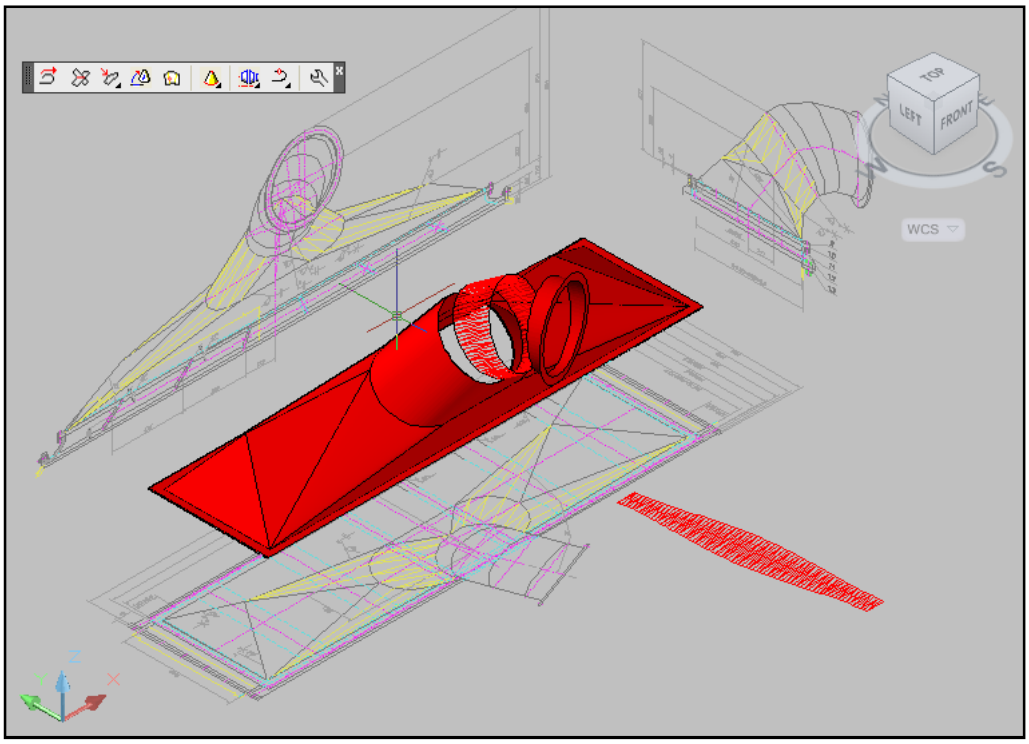

Fig. 11. Using polyface meshes for visualization

To create the selection set:

- Select the 1st definition curve.

- Select the 2nd definition curve.

- Press Enter to complete the selection set.

The decomposition of the surface into triangles depends on the optimization mode selected. It should be the same as those used in sm_unfold command

Use AutoCAD's *shade* command to make the mesh visible.

Unroll polyface mesh

SM_UNROLL

This command unrolls the polyface mesh created using the *sm_pfmesh* command onto the surface's cutout.

Be sure to **use the same settings and order as the ones used during the generation of the cutout**.

The *unroll polyface mesh* command requires a selection set consisting of 2 of the surface's

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definition curves, the baseline of the surface's cutout and the mesh. The order in which they are selected is important. ONLY one entity may be selected at a time.

To create the selection set:

- Select the surface to be unrolled.

- Select the 1st definition curve.

- Select the 2nd definition curve.

- Select the baseline of the surface's cutout.

- Press Enter to complete the selection set.

Be sure to use the same optimization mode setting as was used when created the cutout.

Roll back polyface mesh

SM_ROLLBACK

This command rolls the polyface mesh from the surface's cutout back onto its parent surface.

Only the polyface meshes that have been created using SurfMaster's *unroll* command and modified using its *cut mesh* command may be rolled back.

Be sure to **use the same settings and order as the ones used during the generation of the cutout.** The *roll back* command requires a selection set consisting of 2 of the surface's definition curves, the baseline of the surface's cutout and the mesh. The order in which they are selected is important. ONLY one entity may be selected at a time.

To create the selection set:

- Select the 1st definition curve.

- Select the 2nd definition curve.

- Select the baseline of the surfaces' cutout.

- Select the surface to be rolled back.

- Press Enter to complete the selection set.

The polyface meshes created in this way are used for 3D visualization purposes only. You can visualize the decomposition of the polyface mesh to triangles by using the SM_TESTMESH command, which is not part of the SM 4 menus.

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Cut mesh

SM_CUTMESH

This command cuts an unrolled mesh or part of it into two or more parts using a closed cutting contour.

The selection set should consist of the mesh and one closed cutting contour.

To create the selection set:

- Select one unrolled polyface mesh or one part of it.

- Select a closed cutting contour.

The produced mesh parts are also polyface meshes, which can be rolled back for visualization purposes.

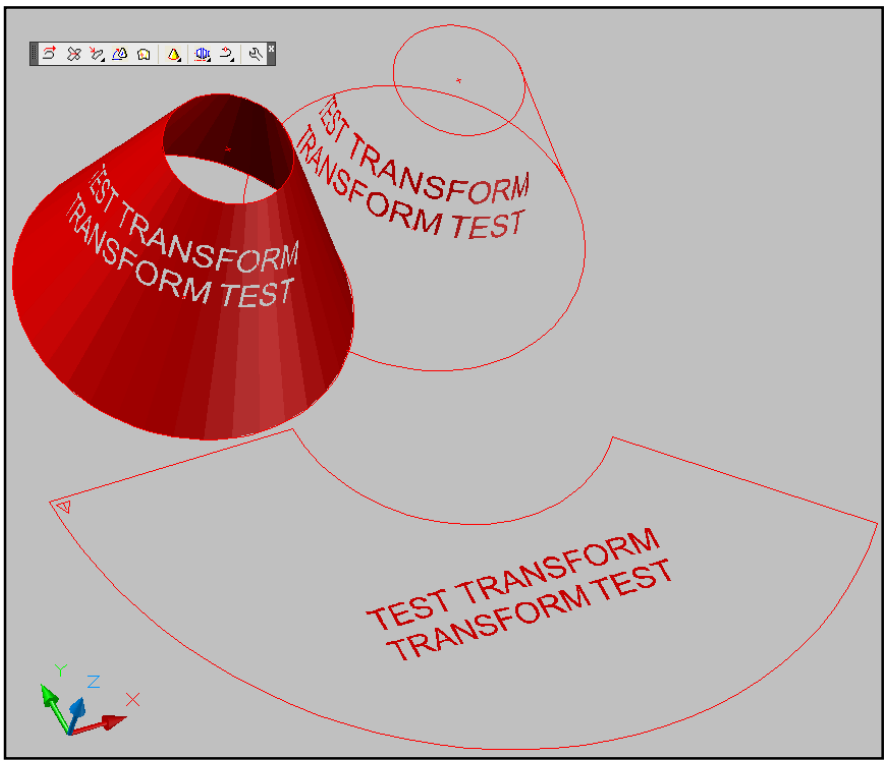

Fig. 12. Unrolling, cutting and rolling back polyface meshes

The SurfMaster mesh handling commands are useful for visualization.

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Construct

SM_CONSTRUCT

This command is very powerful, but is complicated and requires some preparation and attention during its execution. It helps to decompose complicated surfaces defined by their XOY and XOZ parallel projections into a set of single concavity segments that can be unfolded.

Preparations:

- Insert the XOY and XOZ projection of the constructed object into the drawing and ensure that they are of the same scale. The projections can be raster images.

- Draw the OX and OY axis onto the XOY projection, starting from the origin O.

- Draw the OX and OZ axis onto the XOZ projection, starting from the origin O.

- Draw the upper overall dimensions line of the XOY projection of the constructed object (drawing the lower one is optional). If you do not draw the lower line, the Y coordinates of the object will be considered symmetrical to OX.

- Draw the left overall dimensions line of the XOZ projection of the constructed object (drawing the right one is optional). If you do not draw the right line, the Y coordinates of the object will be considered symmetrical to OX.

- Draw from top to bottom /not necessarily parallel to the OY axes/ the vertical lines, which mark the places for the formers. These lines define the planes of the definition curves of the surface's segments. The planes pass through these lines and are perpendicular to XOY plane.

The *construct* command requires five selection sets, which should include all of the lines created in the same order during the preparation.

To create the selection sets:

- Select the OX line on the XOY plane.

- Select the OY line on the XOY plane.

Press Enter to complete the first selection set.

- Select the OX line on the XOZ plane.

- Select the OZ line on the XOZ plane.

Press Enter to complete the second selection set.

- Select the upper overall dimensions line on the XOY plane.

- Select the lower overall dimensions line on the XOY plane (optional).

Press Enter to complete the third selection set.

- Select the left overall dimensions line on the XOZ plane.

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- Select the right overall dimensions line on the XOZ plane (optional).

Press Enter to complete the fourth selection set.

- Select all of the lines that define the definition curve planes.

Press Enter to complete the last selection set.

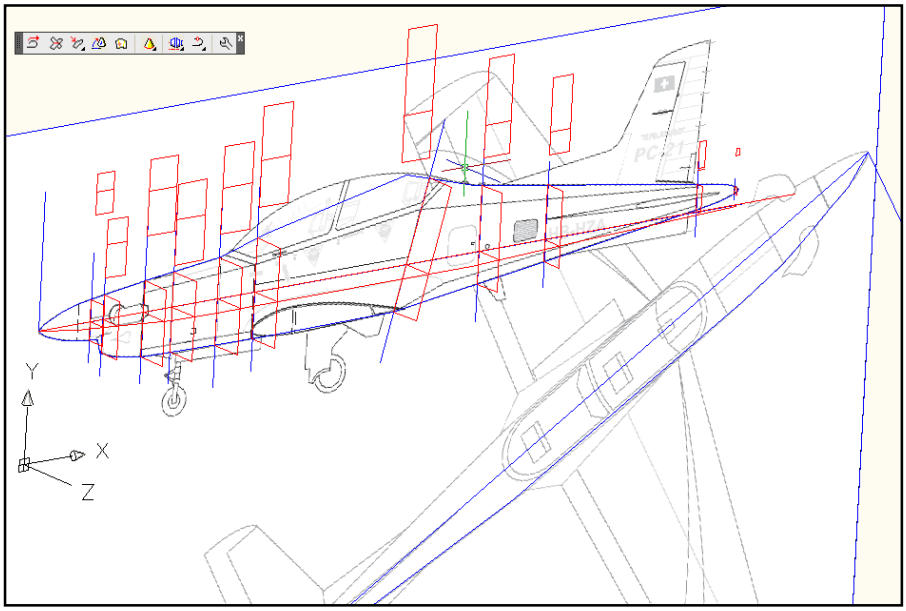

Fig. 13. Using the "construct" command

The *construct* command creates rectangles with overall dimension lines of the object's definition curves and places them on the corresponding section planes. The top and the left lines of the rectangles are joined and create a 3-point container to be used for transformation purposes. The YZ sections together with the containers can be placed on the XOY plane using the *sm_former* command to make drawing of the definition curves easier. These curves can then easily be returned to their places in 3D space by using the containers through the *transform* command.

Transform

SM_TRANSF_C

SM_TRANSF_L

Both of these commands do the same thing and differ only in the defining of the transforming points. They perform either 3-point 3D affine transformation or 4-point planar perspective transformation. The first of the two commands uses a pair of contours or *containers* that contain 3 or 4 vertices representing the source and destination control

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transform points. The second one uses 3 or 4 lines for the same purpose.

The purpose of these commands is to apply a transformation sequence on a source objects in a way that 3 or 4 points that are part of them and are known coincide with 3 or 4 other points that are known too. This is similar to AutoCAD's *align* command.

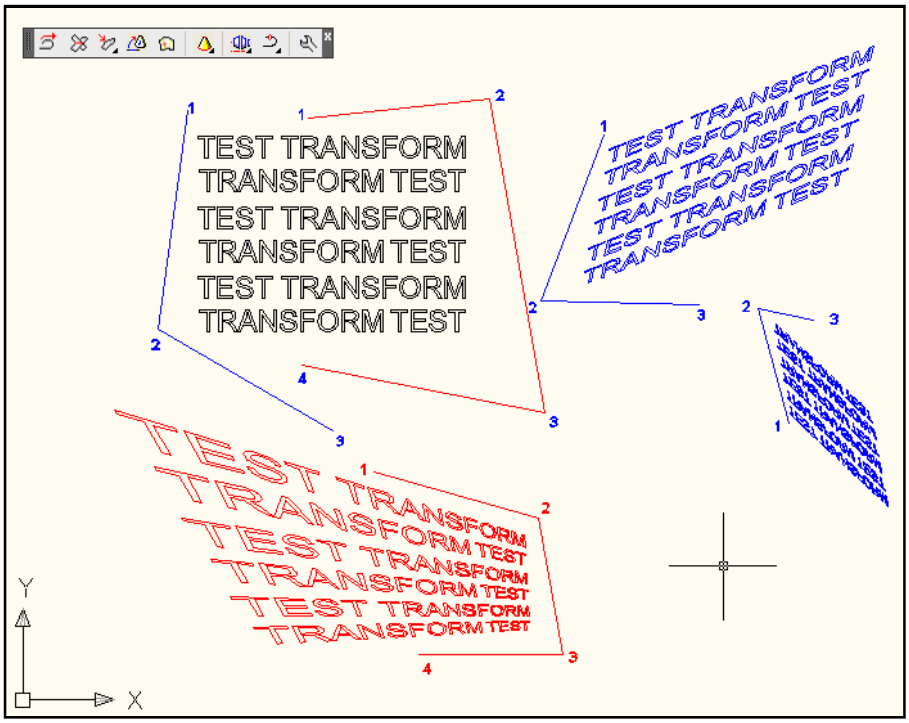

Fig. 14. Affine and perspective transformations

The two *transform* commands each require two selection sets. The first set consists of the source and destination containers, and the second one comprises transformed objects.

Extract formers

SM_FORMER

This command aligns formers from 3D space onto XOY plane.

The command requires a selection set consisting of the planar formers' contour, which in most cases is some surface's definition line, the formers' base and, optionally, a container and other details coplanar to the former.

The material thickness correction option is not provided in this version of SurfMaster.

Such correction can be done using AutoCAD's *offset* command on the contour that has been converted to a 2D polyline in advance.

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Container for 3p transformation

SM_CONTAINER

This command creates a 3-point container out of an object lying on the XOY plane by using the object's overall X and Y dimensions. This container is compatible with the containers created using the *construct* command. By using such containers, the section's definition curves can easily be moved from 2D to 3D space and vice versa.

The selection set should contain the processed object as a first entity. The object should be planar and should lie on the XOY plane.

Connecting strip

SM_CSTRIPE

This command creates a connecting strip used to glue adjacent segments to each other.

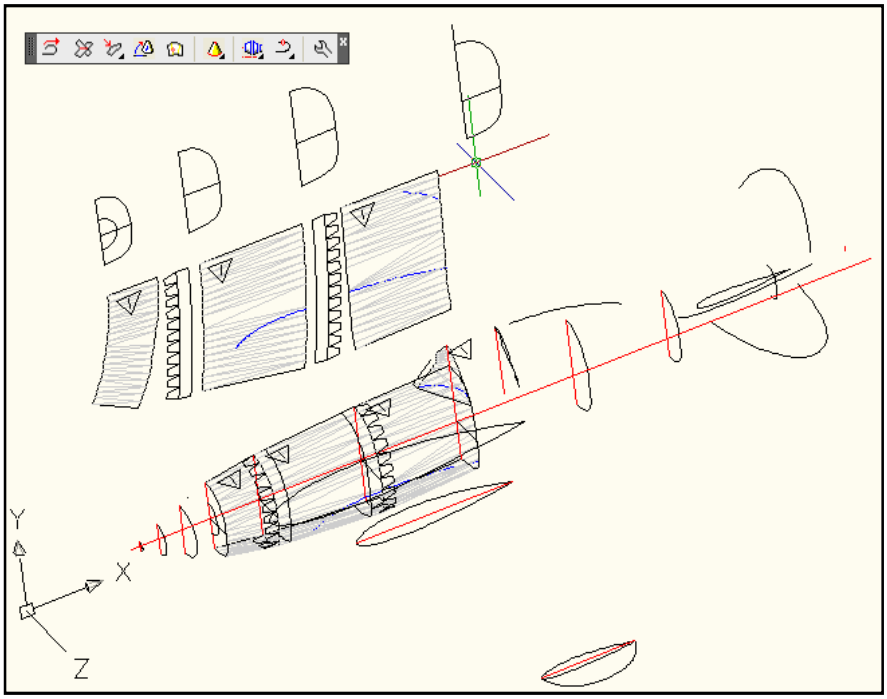

Fig. 15. Connecting strips and formers

The style, size and parameters of the connecting strip depend on the corresponding parameters, which can be set using the *sm_config* command.

The direction of the connecting tabs depends on the place of the point entered for selecting the object.

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Fold marks

SM_FMARK

This command adds fold marks to a line that has to be scored.

Just select a linear entity near the edge where the folding mark should be drawn. The length of the folding mark can be set using the *sm_config* command.

3D polylines

SM_PLN3D

This command converts all of the entities supported by SurfMaster into 3D polylines. The supported entities are:

- lines

- 3D polylines

- 2D polylines containing straight and arc segments

- splined 2D or 3D polylines

- splines

- circles

- ellipses

- arcs (circular and elliptical)

After the entities have been converted, the center marks of the circles, elliptic and arc entities or sub-entities are added. In the case of ellipses or elliptical arcs, the center marks also carry information about their axes aspect ratio.

The command also allows old-style AutoCAD mesh surfaces to be used as input and can decompose them into **M**- and **N**-direction curves.

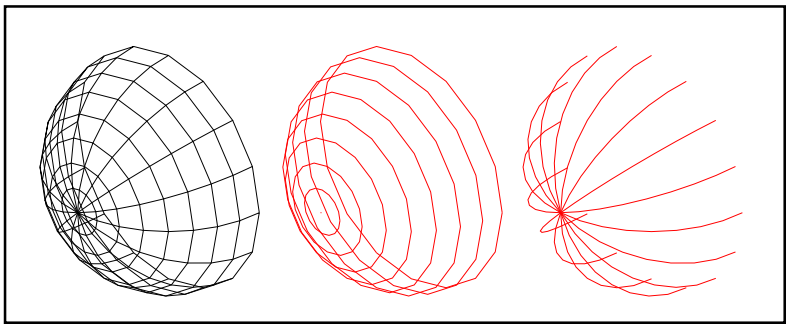

Fig. 16. Decomposition of a dome into M- or N- direction 3D polylines

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All of the curved entities are decomposed into a sequence of straight lines. The precision of approximation depends on the ARC_APROX_ANGLE variable, which can be set using the *sm_config* command. The precision with which splines are decomposed precision depends on the MIN_SEG_LENGTH, MAX_SEG_DEVIATION and MAX_SEG_LENGTH variables, which are the same as in the *sm_refine* command.

There are no special requirements for the creation of a selection set for this command.

The original entities are deleted.

2D polylines

SM_PLN2D

This command converts all of the entities supported by SurfMaster into 2D polylines made up of only straight segments, thereby projecting the entities onto the XOY plane. The supported entities include: lines, arcs, circles, 2D simple, fitted or smoothed LW polylines, 3D polylines, splines, ellipses and elliptical arcs.

All curved entities are decomposed into a sequence of straight lines. The precision of approximation depends on the ARC_APROX_ANGLE variable that can be set using the *sm_config* command. The precision with which splines are decomposed depends on the MIN_SEG_LENGTH, MAX_SEG_DEVIATION and MAX_SEG_LENGTH variables, which are the same as in the *sm_refine* command. There are no special requirements for the creation of a selection set for this command.

This command is very useful for flattening the 3D design by parallel projecting it onto the XOY plane.

The original entities are deleted.

Refine polylines

SM_REFINE

This command removes the unnecessary vertices, reducing their number to some minimal value needed to represent the shape of the contour.

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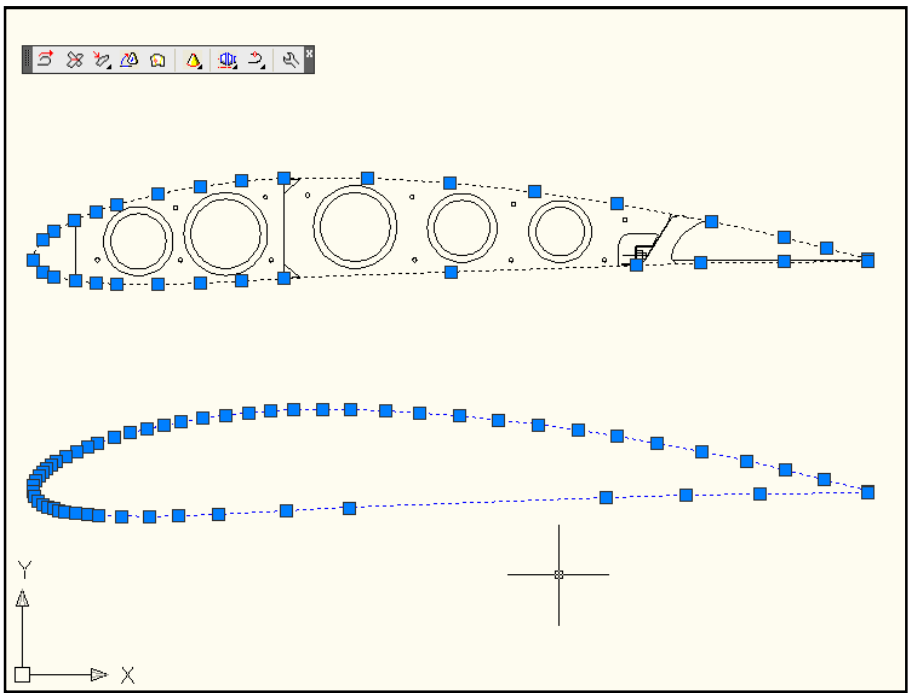

Fig. 17. Converting a spline to a 3D polyline using the "refine" command

The precision of approximation depends on the MIN_SEG_LENGTH, MAX_SEG_DEVIATION and MAX_SEG_LENGTH variables. The original entities are deleted. There are no special requirements for the creation of a selection set for this command, except that it should contain only one element.

This command is very useful for processing the intersection lines between surfaces.

Resample polyline

SM_EDIST

This command resamples a polyline to create a 3D polyline with a preset number of vertices.

There is also an option to preserve apexes with an angle greater than some preset value. The preserving apexes and their minimal angle can be controlled globally using the *sm_config* command, or locally for the current implementation using the dialog box.

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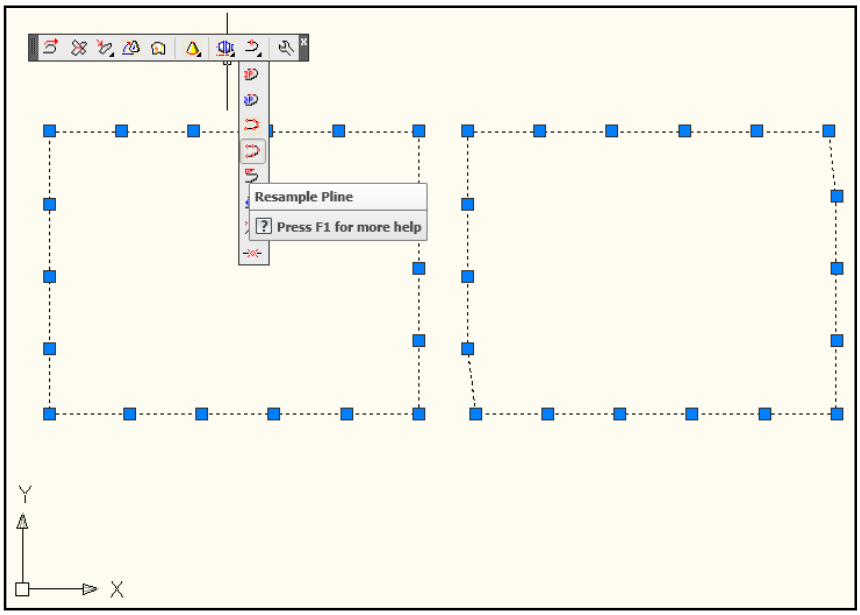

Fig. 18. Resampling with and without preserving a sharp apex

This command can be very useful when preparing the definition curves of twisted surfaces since the optimized unfolding algorithms cannot provide the necessary level of accuracy.

The selection set is limited to only one entity.

Start mark

SM_SMARK

This command is useful for showing the origin and the direction of the contour. It places a small triangle at the start of the contour, pointed among its direction. No automatic update of the start mark is performed after reversing the contour's order.

Reverse the order of a contour

SM_REVORD

This command helps to avoid the so called "basket effect" and reverses the order of the contours that have been passed, converting them to 3D polylines.

There are no special requirements when creating a selection set for this command. The only requirement is that valid entities should be passed to it.

The original entities are deleted.

The order and the origin of the contour can be visualized by placing start marks on them using the *sm_smark* command.

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Join contours

SM_JOINPL

This command joins the coinciding edges of the selected contours, producing one or more 3D polylines. There are no special requirements for the creation of a selection set for this command. The old contours are deleted.

Split contours

SM_SPLIT

This command splits open or moves the origin of the closed contour or pair of contours.

To use this command, a split line should be drawn. The contour or pair of contours are split at points that are nearest to its edges.

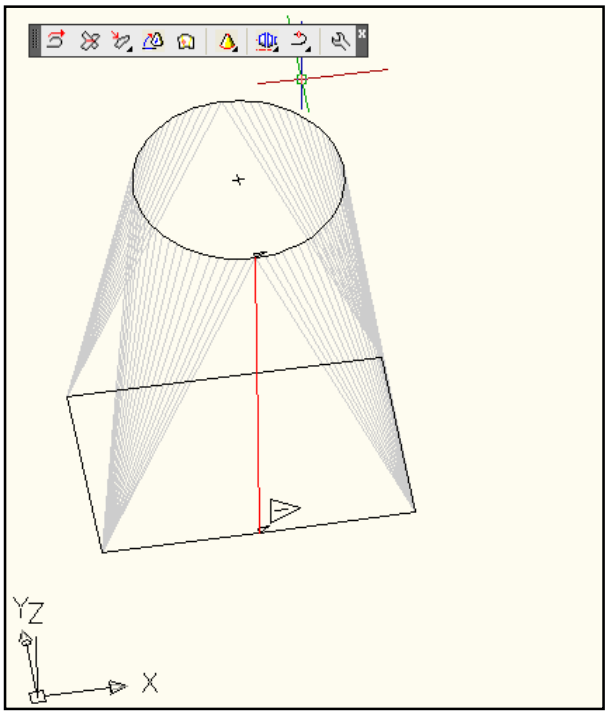

Fig. 19. Splitting contours. (Note the start marks that show their origin and direction.)

The *sm_split* command requires a selection set comprising one or two contours and the split line. ONLY one entity may be selected at a time.

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To create the selection set:

- Select the 1st curve for splitting.

- Select the 2nd curve for splitting (optional).

- Select the split line.

- Press Enter to complete the selection set.

This command is very useful for setting the origin for unfolding of closed surfaces.

It can also be used to eliminate the difficulties arising when surfaces containing twisted areas have to be unfolded. In this case, splitting the surface into several parts is very effective.

Configuration

SM_CONFIG

This command is used to set the values of all of the user-accessible parameters so that SurfMaster can work properly. Once the command has been started, the following dialog box appears:

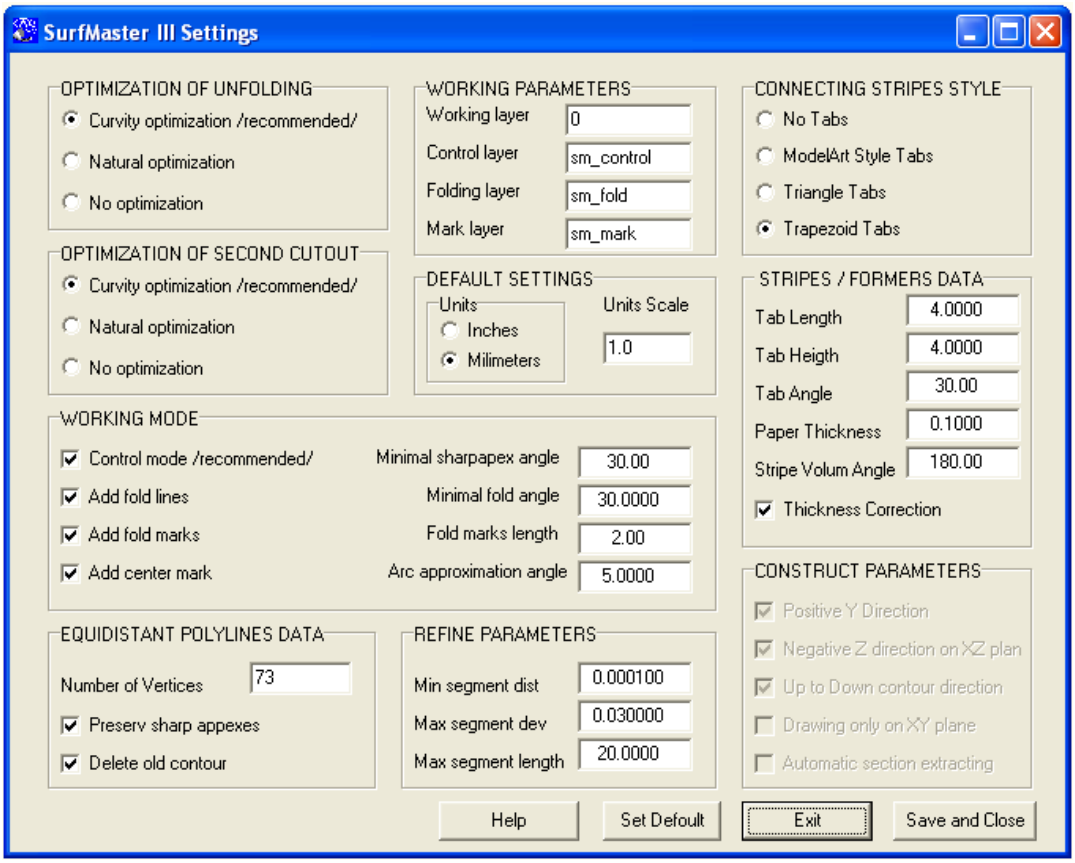

Fig. 20. SurfMaster Configuration Settings dialog box.

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The **Optimization Mode** panel contains three choices for selecting the desired mode. The Optimization Mode for the second cutout panel is used during execution of the *sm_interx* command, when two segments are passed to it. In case that intersection lines are also being drawn on the cutouts, both the first and second optimization modes should be the same as those used to create the cutouts in the first place. To determine which modes were used to create the cutouts, refer to the origin marks. The *curvature optimization* mode is recommended as the default.

The **Working Parameters** panel is used to set the names of the layers used for placing the entities produced during the SurfMaster commands execution.

The **Working Mode** panel helps to set certain very important parameters the SurfMaster commands can work properly. These parameters are preset to use the metric system and 1 mm drawing units. If inches or any other units are used, all of the length parameters should be changed to the appropriate values. (Note: 1 inch is equal to approximately 25.4 mm.) The same holds true for the angular parameters, which are in degrees by default.

The left column of check boxes in the Working Mode panel controls the appearance of the control triangles, fold lines, fold marks and center marks.

The right column of edit boxes sets the parameters as follows:

Minimum sharp apex angle: This box is used if the *Preserve Sharp Apexes* option in the Resample Polyline panel has been selected. If this box is checked, all apexes with angles greater than this value will be preserved.

Minimum fold angle: All of the volume angles between adjacent triangles will produce fold lines and marks if the corresponding modes are on.

Fold mark length: This box is used to sets the length of the fold marks. The size of the center and origin marks is also proportional to this parameter.

Arc approximation angle: This parameter sets the precision of approximation of arcs and circles with polylines composed of a sequence of straight lines. It sets the center angle of the pairs of vertices placed on the arcs or circles.

The **Equidistant polylines data** panel has a edit box for setting the desired number of vertices for polyline resampling and a check box for selecting the preserve sharp apexes option.

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The **Connecting Stripes Style** panel controls the way the connecting strip tabs are created. Four modes are available: no tabs, rectangular tabs, triangular tabs and trapezoidal tabs.

The **Connecting Stripes / Former Data** panel controls the size of connecting tabs (i.e., the height, length and angle of the trapezoidal tabs). Options to specify and correct the paper thickness are also available.

The appropriate values should be entered in the **Refine Parameters** panel in order to ensure that the *sm_refine* command will be used effectively.

The **Construct Parameters** panel is not active and is reserved for later use.

Use the Set Default button to retrieve the default settings based on the units that are currently being used and the size of the objects being worked with.

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Your Maiden Flight with SurfMaster

Exercise 1

SurfMaster unfolding

This exercise is intended to become familiar with the SurfMaster unfolding engine and for acquiring the basic skills needed to successfully use the SurfMaster pack.

In this exercise, you will learn:

- How to use definition curves to create a cutout
- How to deal with control lines and layers
- How to use information supplied by cutout marks
- How to set the cutout origin

Open a new drawing using the *acadiso.dwt* template. Please note that SurfMaster is preset to use the metric system by default and that one drawing unit corresponds to 1 mm. This can easily be changed using the *sm_config* command if you are working with the imperial units.

Let's create your first segment to be unfolded: a cylinder. Draw a circle somewhere in the drawing area with a radius of 100 drawing units. Copy it by entering @0,0,200 for the second point of displacement.

Use the steering wheel or navigation cube or set the viewpoint to 1,-1,1 to view your cylinder in space.

Now choose the *sm_unfold* command from the SurfMaster menu and select the two circles. Press Enter to complete the selection and enjoy the results. The triangle decomposition control lines appear, and the origin of the unfolded cutout "sits" on the cursor. Complete the command by moving the cutout to the desired location. (Note: The produced cutout can easily be moved again by entering "p" for "previous" when selecting objects to be moved.)

If an error occurs or nothing happens, press Esc a few times and check whether SurfMaster has been installed properly.

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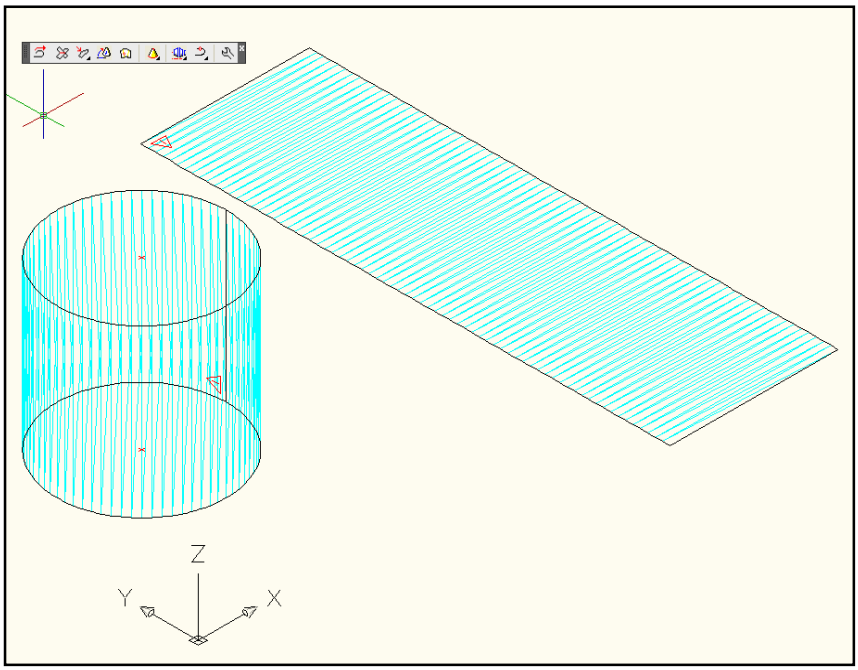

Fig. 21. A cylinder and its cutout

If everything is OK, continue to examine the results. You can delete control lines by executing the *sm_cclear* command.

Note the position of the origin marks both on the 3D segment and on its cutout. Since the order in which the segment's edges and the cutout's baseline are selected is important for eventual future processing, these marks help to maintain orientation.

Now, copy the two circles to some other place and unfold the cylinder, changing the selection order. Compare the result with previous one. Note the new location of the cutout mark. Try to imagine the front and the back sides of the cutout. In one of the cases, if you consider the outer side of the cylinder as the surface's front side, the cutout appears as a mirror image.

You can move, scale and rotate the two circles in 3D space and produce cutouts of the new inclining and/or conical segments that they defined.

It is a good idea to change the default colors of the control, fold and mark (e.g., to yellow, red and blue, respectively.

After doing some experimenting, you may decide that you don't like the position of the cutout's origin. You can change this by using the *sm_split* command. If the split definition curve(s) is closed, this command changes its origin location. The opened curves are split into two parts. The resulting definition curves are converted into 3D polylines. For more precise results, when definition curves contain non-linear parts, such as arcs or splines, they can be converted into 3D polylines prior to being split.

Draw a rectangle somewhere on the XOY plane with sides measuring 100 and 80 drawing units, respectively. By using coordinate filters or a temporary diagonal, draw a circle with a radius of 30 and center in the middle of the rectangle. Move the circle 100 drawing units in direction Z.

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If you try to unfold that surface, you will not get the desired result. The reason for this is that the origin of the cutout has not been set properly. Draw the start marks of the two curves by executing the *sm_smark* command. You can see that they are not in the correct place. To place them in the desired positions, you should draw a line or a 3D polyline between points where you want the cutout to start.

This can be done as follows:

Draw a line from the middle of one of the rectangle's sides perpendicular to the nearest side of the circle using the corresponding snap mode.

Start the *sm_smark* command and examine the start points and directions of the obtained definition curves.

If the definition curves appear in opposite directions, change the order of one of them by using the *sm_revord* command.

Unfold the surface.

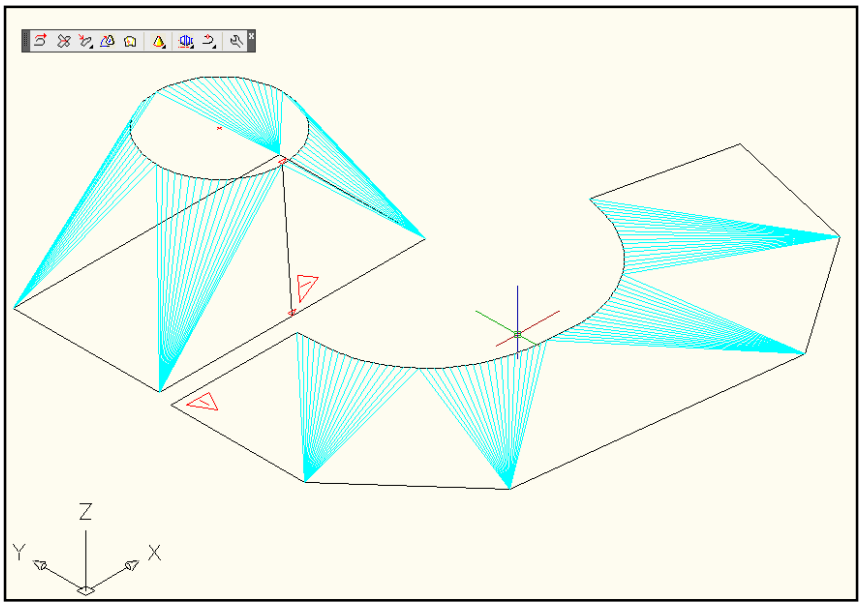

Fig. 22. Unfolding a segment with a rectangle-to-circle transition.

The result should be similar to the illustration shown in Fig. 20. You can play with some variations to this procedure:

1. Generate the cutout again this time creating the selection in a reversed order, and compare the results.
2. Or, instead, reverse the order of both definition curves.

So far, you have worked solely with surfaces that are more or less smooth. Let's see what happens if there are sharp edges involved.

Draw a rectangle with the dimensions of 40 x 60 units on the XOY plane and make a copy of it 50 units away in direction Z.

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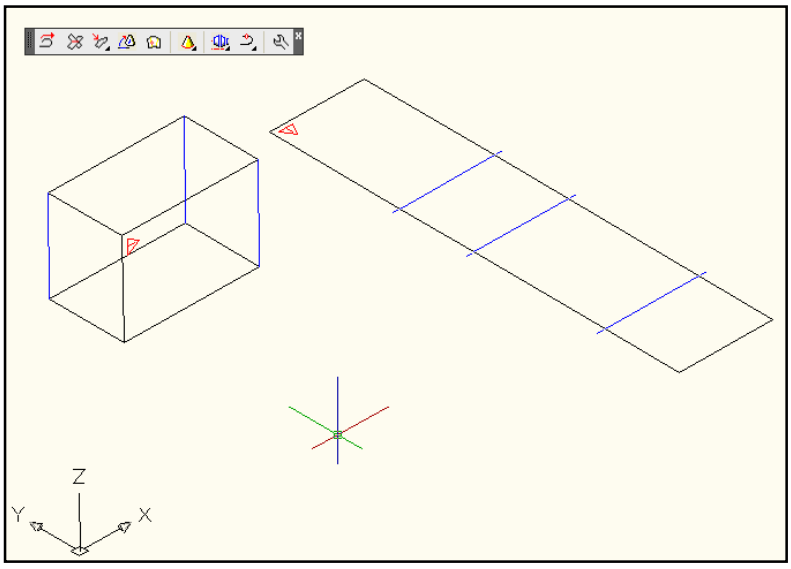

Fig. 23. Unfolding a rectangular parallelepiped

Create the cutout by using the *sm_unfold* command.

Remove the control triangles' decomposition lines using the *sm_cclear* command.

Note that SurfMaster draws fold lines both on the surface and on its cutout and fold marks outside of the cutout as a continuation of the fold line. You can control the appearance of the fold lines by setting the minimum fold angle value via the *sm_config* command.

We will complete this exercise by becoming familiar with one more class of surfaces that differ topologically from the ones we have just worked with. These are conical surface.

Please take the following steps:

Draw a circle somewhere on the XOY plane.

Create the start mark that points to the origin of the closed curve by executing the *sm_smark* command.

Draw a line or 3D polyline from the center of the circle to the origin indicated by the start mark using the end snap mode.

Select the grip of the line that is in the center of the circle and move it 100 drawing units in direction Z.

Unfold the surface.

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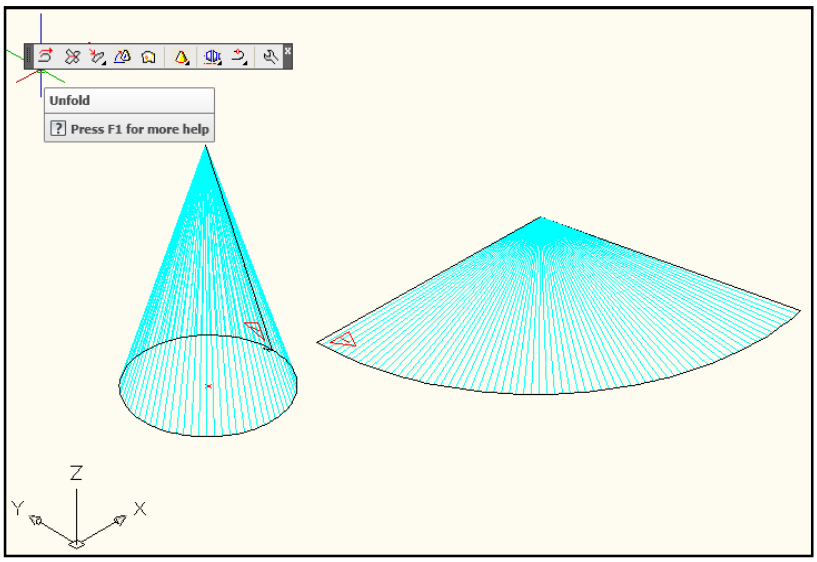

Fig. 24. Unfolding a conical surface

You can also try and produce a pyramid in a similar way.

So far, we have used one or two closed curves to define surfaces. Symmetry makes things easier as we can work half of the surfaces only.

Exercise 2

Working with surfaces

This exercise is intended to help users become familiar with SurfMaster's intersecting and drawing in direction X, Y or Z functions.

In this exercise, you will learn:

- How to obtain intersecting curves between two 3D surfaces

- How to control their appearance on the surface's cutouts

- How to project linear entities onto the surface and, optionally, on its cutout by creating a linear projection of them in directions X, Y or Z

- How to fold linear entities drawn on the cutout back onto its 3D parent surface

Open a new drawing as you did in the **Exercise 1** by using the *acadiso.dwt* template. Please note that SurfMaster is preset to use the metric system by default and that one drawing unit corresponds to 1 mm. This can easily be changed using the *sm_config* command if you are working with the imperial units.

On the XOY plane, draw a pair of intersecting circles with a radius of 30 units and with a distance of 40 drawing units between their centers. Make a copy them 100 drawing units

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away in direction Z.

You have just defined two inclined cylinders. Unfold both of them using the *sm_unfold* command.

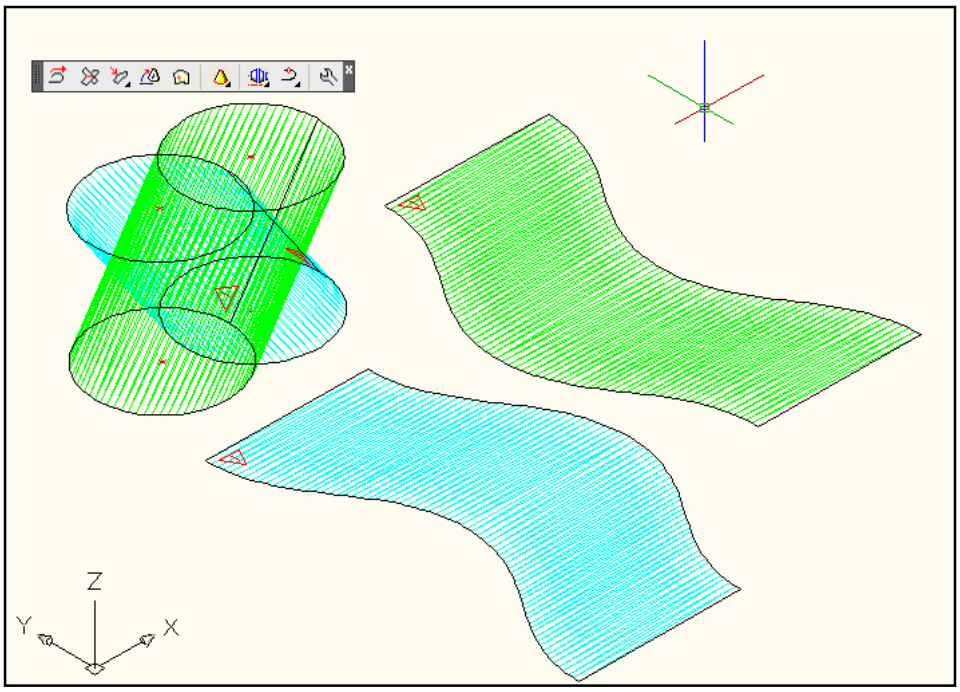

Fig. 25. Defining two intersecting surfaces

Remove the control lines using the *sm_cclear* command.

As you can see, apart from the cutout marks and the cutout contours, everything that reminds us of the surfaces' existence has disappeared. This is the part that is difficult to get used to. The surfaces exist not as a drawing object, but as a "potential object" whose geometry may be regenerated using triangle decomposition. The existence of their two definition curves and SurfMaster's unfolding algorithm are the conditions for this "virtual existence" . The following example proves that.

Start the *sm_interx* command and strictly follow the same sequence as the one used during the creation of the selection set. Use the cutout origin marks for orientation. Select the first and second definition curves of the first cutout. Then, select the first and second definition curves of the second cutout. Finally, select the baseline of the first cutout and then of the second cutout.

The intersection lines together with the control decomposition lines will be drawn. If the control lines differ from those created during the cutout generation, a mistake has been made while creating the selection set. Undo and try again.

If everything is correct, you will see the intersection lines both in 3D space and on the surfaces' cutouts

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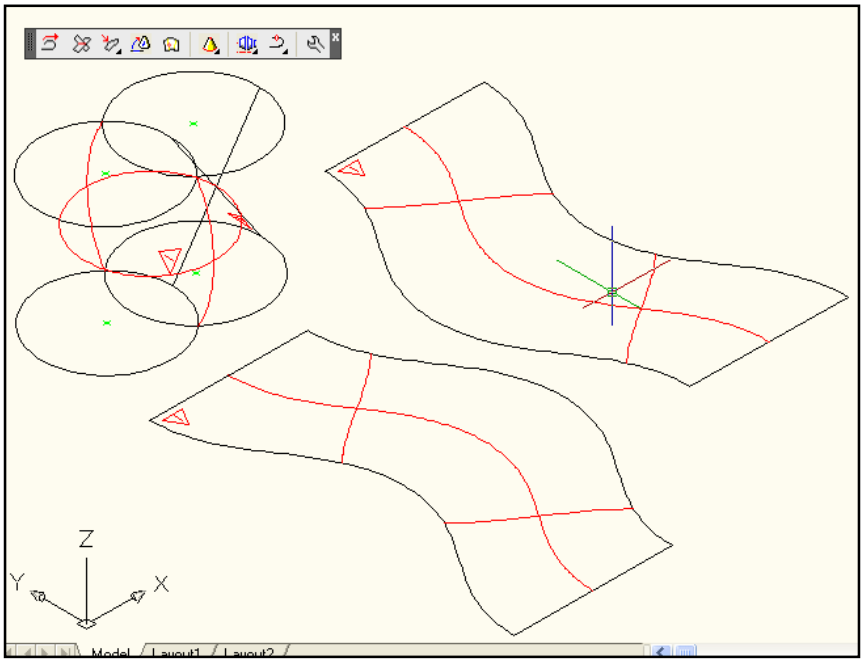

Fig. 26. Drawing the intersection lines between two surfaces

You can experiment to see what will happen if you slightly scale some of the circles up or down and obtain the new surfaces' intersection lines. Use the steering wheel or 3D orbit to examine the results.

SurfMaster uses the *sm_interx* command as the basis for three additional very similar commands combined in the **draw in direction** flyout (dropdown) menu toolbar. These commands are: *sm_drawx*, *sm_drawy* and *sm_drawz*. Each of them requires a selection set comprised of the surface's definition curve and, optionally, its cutout base. After pressing Enter, the entities that to be projected must be selected. SurfMaster creates temporary surfaces, extruding these in the desired direction, and calculates the intersection lines just as the *intersect* command does.

Define the pyramidal surface, drawing a rectangle on the XOY plane and a line or 3D polyline from the rectangle origin to the apex located 100 drawing units away in direction Z.

Draw few concentric circles with centers at the projection of the apex on the XOY plane.

Unfold the pyramid.

Start the *sm_drawz* command. Select the pyramid's definition curves and the cutout baseline. Press Enter and then select the circles drawn.

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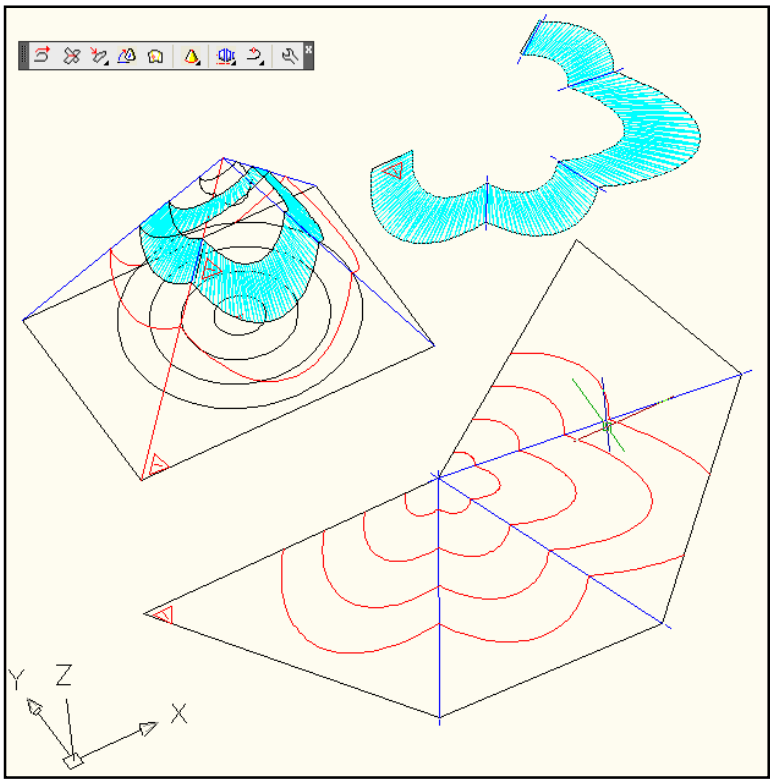

Fig. 27. Drawing circles in direction Z on the pyramidal surface. Using a pair of the obtained lines as new definition curves

Examine the intersection curves from different viewpoints. They should look like a chain of elliptical spirals. Click on one of them to view their vertices, shown as grips.

You can see that there are many unnecessary vertices. Try to use the *sm_refine* command to reduce them to the minimum quantity needed to maintain the line's shape.

Try using a pair of the resulting intersection curves in 3D space to define a new surface to be unfolded. Don't forget to refine them first.

You can experiment with a set of additional objects that you can draw and project on the surface.

One of the most interesting abilities of the SurfMaster pack is the fold back function. This function makes possible to draw details on the cutout using easy 2D geometry and to then put the details on the parent surface in 3D space.

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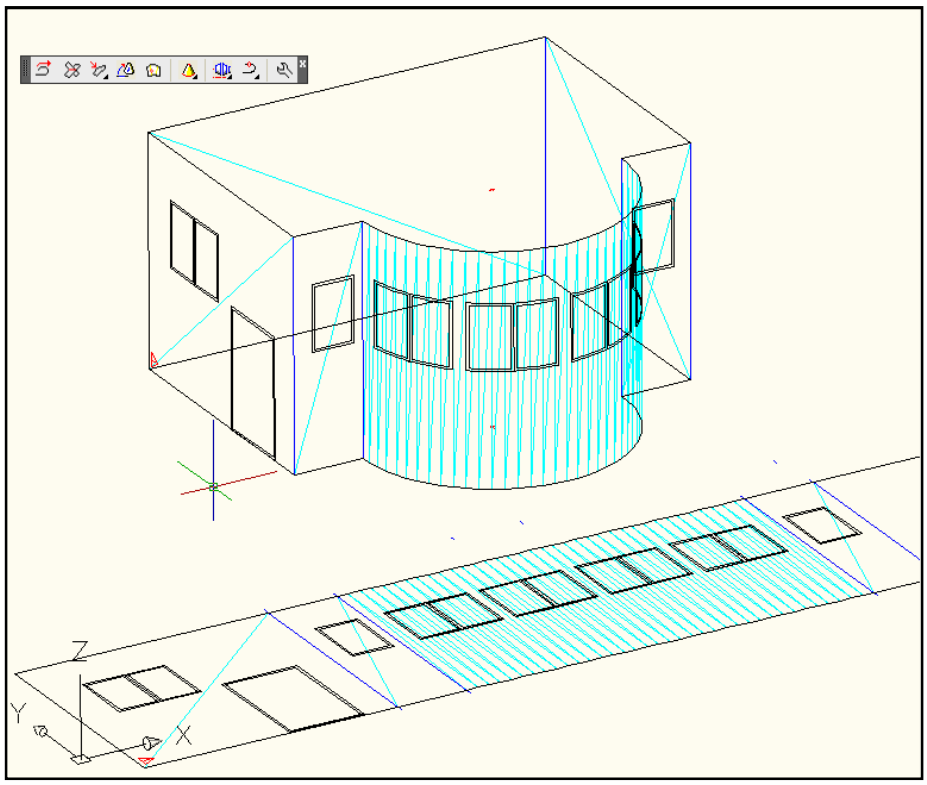

Fig. 28. Folding a door and windows from a cutout back onto a façade in 3D space

Draw a rectangle somewhere on the XOY plane and a circle with its center in the middle of one of the rectangle's sides. Use AutoCAD's *break* command to obtain the base contour of a building. Use the *sm_joinpl* command and select the rectangle part and arc to create the first definition curve of the fade. Make a copy of the obtained contour some distance away in direction Z. Draw a line or 3D polyline between two corresponding corners, from where the cutout will start. Use the *sm_split* command to split contours at starting points, selecting two contours and the start line. Unfold the façade. Draw the door and windows on the cutout. Start the *sm_foldback* command. Select the first, then second contour. Select the cutout's baseline, then the door and windows. Press Enter. You can see how easy it is to position the complex objects in 3D space. The fold back function can also be used to define some complex definition curves.

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Exercise 3

Preparing your 3D model

In this exercise, you will learn how to:

- Use AutoCAD drawing entities to define definition curves

- Use SurfMaster's auxiliary commands to edit definition curves

- Use geometric transformations of similar objects

- Create complex 3D objects by defining the segments of their skin surfaces

- Visualize SurfMaster surfaces.

Working with definition curves

The correct creation of a surface's definition curves is a key factor in the successful use of the SurfMaster software pack. This example is intended to help users become familiar with the SurfMaster's set of auxiliary commands, which are used to prepare good definition curves for the surfaces.

SurfMaster can use the following AutoCAD entities as definition curves:

- lines

- 2D LW polylines with straight and arc segments

- splined 2D LW polylines

-3D polylines

- splines

- splined 3D polylines

- circles

- arcs

- ellipses

- elliptical arcs

- rectangles

- polygons

Note that the last two entities are 2D LW polylines.

The helices can also be used after being exploded into splines. The regions can also be utilized after being exploded into lines that can be joined together using the *sm_joinpl* command.

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There are two different ways to work with definition curves. The first way is to leave the curves as original AutoCAD entities. They will be kept as they are, despite the fact that an approximation with consecutive straight-line segments will be done each time the cutout is calculated.

The other recommended way to work with definition curves is to decompose the original lines manually using one of the SurfMaster commands for dealing with contours. Normally, this is the *sm_pln3d* command. It leaves the straight contour segment straight. The arc and elliptical arc segments are approximated by a sequence of straight line segments. Their density depends on the value of the arc approximation angle parameter. Its value is in degrees and can be set using the s*m_config* command. This command can also be used to preserve sharp apexes found in the contour. The value of the minimum sharp apex angle parameter is used for sharp apex recognition. To prevent the loss of drawing information, SurfMaster automatically draws center marks on the circles, ellipses and arcs found.

Splines are also decomposed into straight line segments. SurfMaster maximizes the length of each segment by constraining the maximum distance between the segment and the curve to be less than the value of *min_segment_deviation* parameter, set using the *sm_config* command.

When working with symmetrical objects, it is **highly recommended** that only one half of them be used. Now, let's try executing the *sm_pln3d* command.

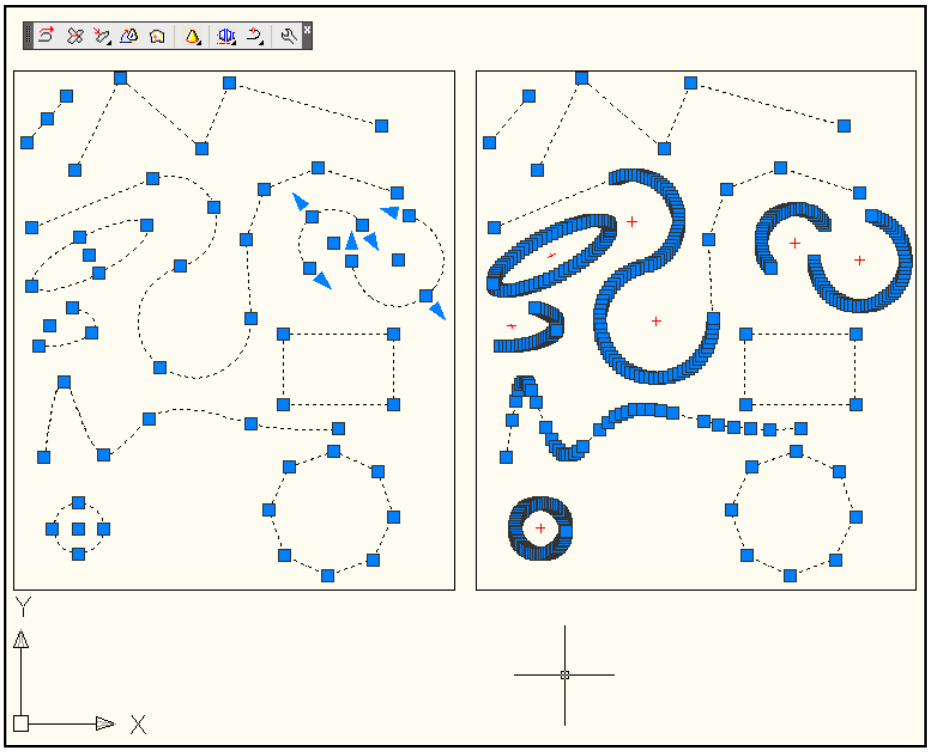

Fig. 29. Converting AutoCAD linear entities into 3D polylines

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Draw the entities mentioned above somewhere on the XOY plane. Make a copy of them somewhere nearby so that they can be compared to the results later.

Execute the *sm_pln3d* command and select the drawn entities. Note the center marks.

Once again, make a copy of the original entities and put them somewhere in 3D space using AutoCAD's *rotate3d* command. Convert them into 3D polylines and examine the results. Now convert them into 2D polylines using the *sm_pln2d* command. You will notice that the all of the entities have been projected onto the XOY plane. The conversion to 2D polylines destroys the Z coordinates.

Using affine transformations

If you have some cross-sections of two parallel 3D projections of a complex object in your 3D view drawing, sooner or later you will face the problem of overdetermination.

Usually, two parallel orthogonal projections are needed in order to determine all of a point's coordinates in 3D space. However, because the projections are represented as lines instead of pairs of points, intersections must be used to determine the coordinates. To do this on a plane perpendicular to both projections, a third view is needed. Therefore, if we determine two of the three W, Y and Z coordinate values for each projection, we can obtain two values for the third coordinate in two different ways. If these two values are the same, the projections are tied and everything is OK. If they differ you will have to assume that one of the projections is correct while the other, although similar in shape has been shrunk.

SurfMaster provides two commands that perform similarity transformations – affine and perspective transformations. The affine transformations are planar 3-points transformations that can be used to unshrink the distorted projection. It is also useful for determining the overall dimensions of an object of similar shape.

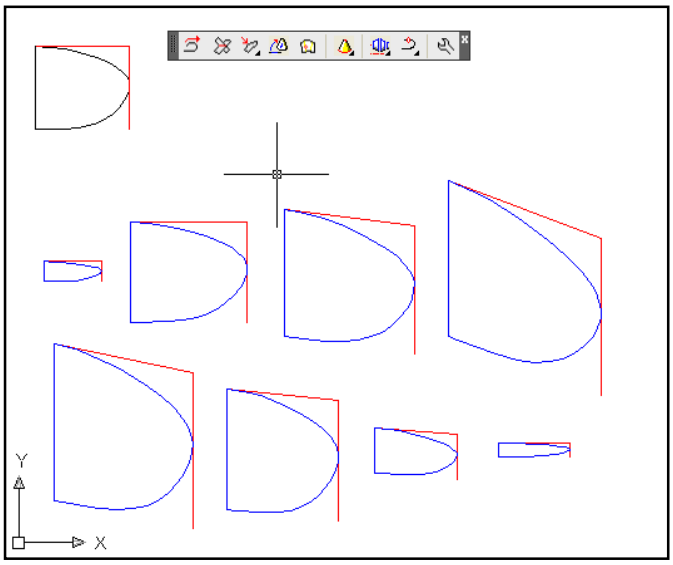

Fig. 30. Using affine transformations to create similar shapes

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To test the transformations, open a new drawing. Then, draw a line of symmetry and some spline to produce an oval shape which will represent a half of a cross-section of a complex object. Draw a container of the spline using the *sm_container* command.

Copy the container to a few other places and stretch them or edit them using grips to produce new containers. Execute the *sm_transf_c* command for each new container. After executing the command, select source, then destination container. Press Enter and select the source shape and its line of symmetry. Press Enter and examine the results. Then repeat command until the task has been complete. Now, try this: Execute the command again, but reverse the order in which the selection set is created.

See, the command can be reversed, the original shape has been recreated. You will also notice that if you use some other edited container together with its shape and line of symmetry as a source on some destination container, you will receive the same results as if you had used the original as a source.

Note also that although the 3-point transformation is planar, the source and destination containers can be placed anywhere with whatever orientation in 3D space.

Constructing complex objects

You can construct complex objects using standard AutoCAD classic commands. You can prepare a set of formers and place them in 3D space using the *align* and *rotate3d* commands. Or, you can create and modify 3D solid and surface objects using commands like *sweep* and *loft* and then obtain definition curves using the *section* command. The sections produced should be exploded into a sequence of lines that have to be joined using the *sm_joinpl* command. If the obtained polyline is closed, its origin should be set using the *sm_split* command. Finally, the direction should be checked by placing a start mark and, if necessary, changed using the *sm_revord* command.

SurfMaster provides a special *sm_construct* command that makes it easier to perform the task of constructing complex objects.

Before testing the command, you will have to do some preliminary preparations. Suppose that you wish to design some complex object. Open a new drawing and draw the coordinate axis for XOY and XOZ orthogonal projections of the object. Draw only one contour on the XOZ plane, supposing that the object is symmetrical to the XOY plane. Draw lines where you would like to place the formers or definition curves of the object' set of surfaces.

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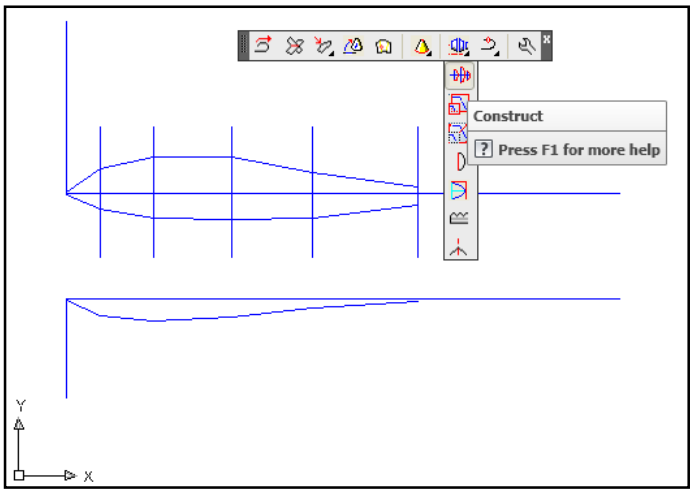

Fig. 31. Executing the "sm_construct" command

Obtain an appropriate 3D view of the drawing by using the steering wheel, the cube or the *3Dorbit* command. Execute the *sm_construct* command, strictly following the command line directions and notifications.

If the selection sets have been created correctly, the results should look like this:

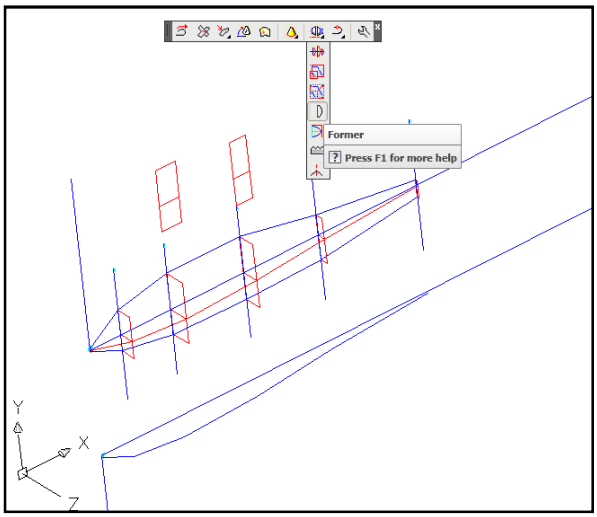

Fig. 32. The results of executing the "sm_construct" and "sm_former" commands

The *sm_construct* command creates overall dimension containers in the locations where definition curves will be placed. You can place these containers together with center lines on the XOY plane using the *sm_former* command.

There, you can draw the desired shape of the former and put it back in its place in 3D space using the *sm_transf_c* command. Or, you can draw some shape with its vertical and horizontal base lines as well as any details and then create the container of the shape using the *sm_container* command. You can then put the shape, baselines and details back into their original places by executing the *sm_transf_c* command.

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Try it by drawing a vertical line and a circle whose center is located on that line. Trim off the left half of the circle and any parts of the line that remain outside of the circle. Execute the *sm_container* command and select the arc.

Then execute the *sm_container* command for each cross-section.

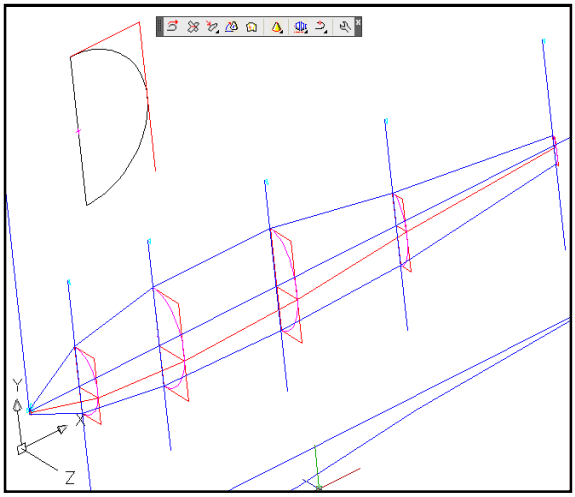

Fig. 33. The surfaces of the complex object have been completely defined

If the selection sets have been created correctly, the result should look like the one illustrated above.

Visualization

You can visualize the objects you have designed using SurfMaster's polymesh creation and cutting tools.

To see the polyface meshes created, select the appropriate 3D visual style or just execute the AutoCAD *shade* command.

Unfold the object's third segment from left to right and delete the control lines if the results meet your expectations. Execute the *sm_pfmesh* command. You should now be able to see the surface. Use the *sm_unroll* command to obtain the surface placed over the cutout contours. Draw a rectangle, circle or any other linear, closed, not intersecting itself curve over the unrolled surface. Execute the *sm_cutmesh* command, selecting the mesh and the closed cutting curve. The mesh will be decomposed into internal and external parts.

Delete the original mesh on the 3D model. Execute the *sm_rollback* command.

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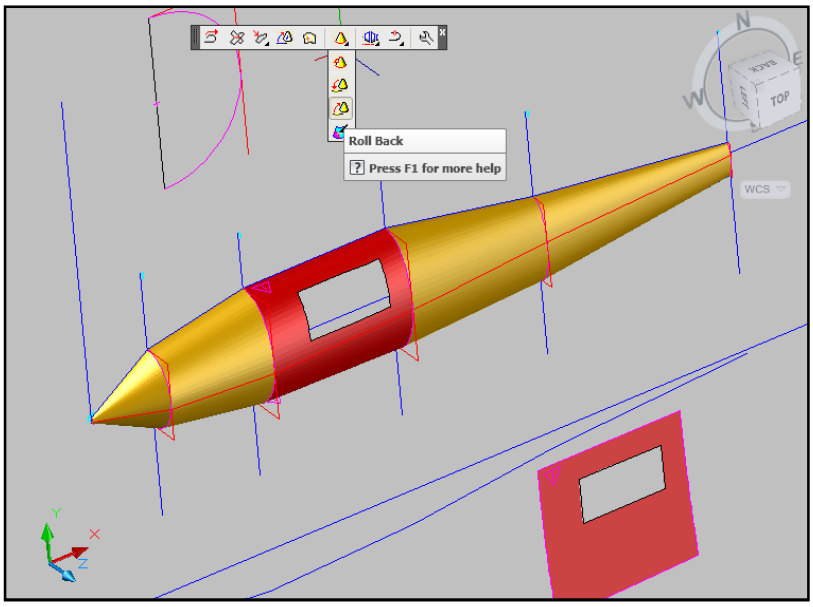

Fig. 34. Visualization of the surfaces

You can continue to create mesh surfaces, unroll them, cut them many times and then roll back the results that you needed. Please note that if you use complex curves as cutting edges, the resulting mesh will be created with too many triangles.

Try to nest the tasks. For example, if you would like to have plenty of round illuminators on your surface segment, it is a good idea to cut rectangles that circumscribe the complex objects and to process each of them one by one. The most important rule is that the all meshes processed should be ancestor of the unrolled mesh.

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Some examples…

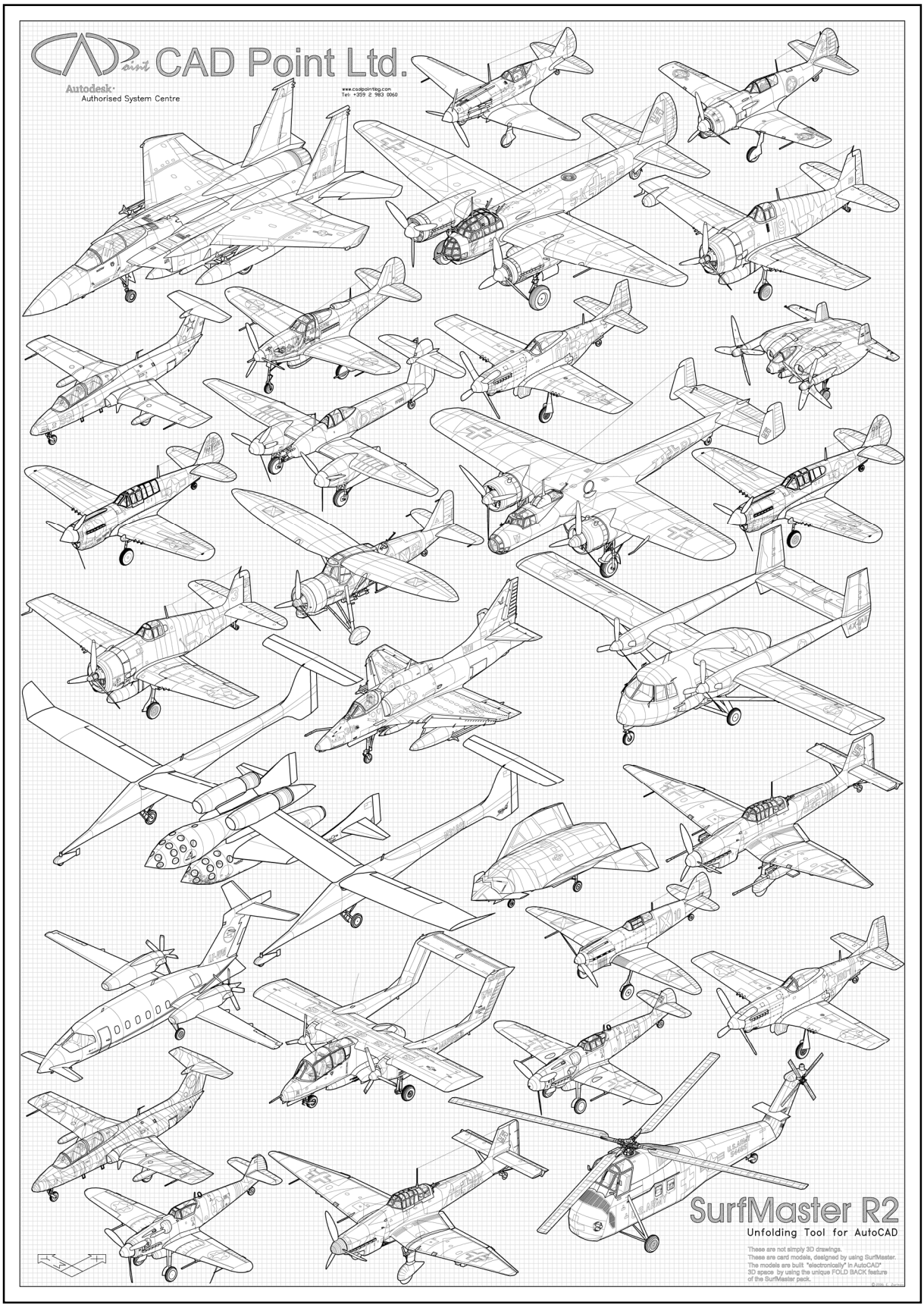

Fig. 35. 1/32 scale paper models created using SurfMaster

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You can find the full-size version of this poster by going to the *all_1_32_illustration.pdf* file in the *docs* folder of your installation pack. It is optimized to be printed on size A3 paper. You can also visit http://www.cadbest.com/ to see the full range of paper models designed using the SurfMaster software pack.

Here is another industrial example of using SurfMaster to design pneumatic cyclones.

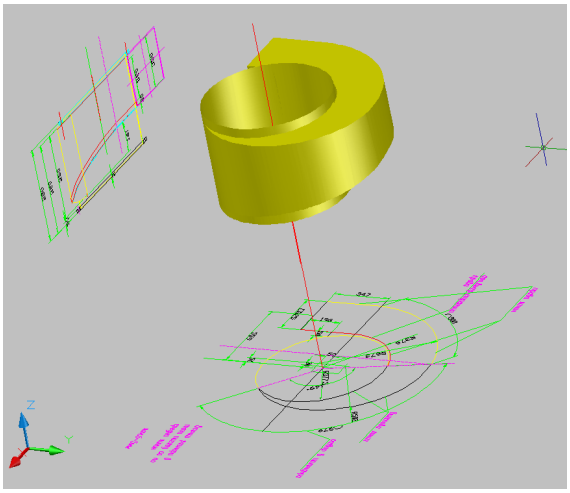

Fig. 36. Designing a pneumatic cyclone using SurfMaster

Fig. 37. Real parts designed with SurfMaster

You can get more practice with SurfMaster by using the DWG files (object definition curves have already been created) found in the *docs* folder of the SurfMaster 4 installation pack.

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Last minute notes

AutoCAD 2010 or later provides a command for reversing the direction of line objects. Another option would be SurfMaster's *sm_revord* command. However, please note that the result of using the latter is always a 3D polyline.

You can also choose either ACAD 2010 or SurfMaster for 2D spline-to-polyline conversion. Please note that SurfMaster creates an approximation of the source spline in 3D space with similar control of accuracy.

AutoCAD 2012 provides command for arrays aligned on a path that you can use for constructing connecting stripes. The SurfMaster *sm_cstripe* command still has an advantage to place the tabs on the connecting stripe adaptively by recognizing the sharp angles on the path.

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Installation

Preparing your setup

- Ensure that your user name has Administrator permissions to install applications on the computer
- After installation, the usage and registration of products work well also without Administrator permissions
- You can obtain serial numbers for all products you want to install from http://cadbest.com/en/products.php. Otherwise you have the option for trial use for two weeks.

Installation process

- Close all running applications and start your setup executable.
- Select next and read License Agreement. If you are agreeing choose “I accept the agreement”.
- Choose which products you want to install.
- Select destination location. Choose a non-protected folder for the installation place of the product. The program Files folder is not suitable, especially if your OS is Windows 7. It is recommended that you use the default **c:\cadbestsoft** folder.
- Once you have installed the pack, your two-week trial period for evaluating the software starts.

AutoCAD Integration

Since the SurfMaster (and zMeasure if you have installed it) are not stand alone applications, you'll have to plug them in a host application that maintains Autodesk® AutoLISP®. The host application can be AutoCAD® 2000 or later, IntelliCAD, or any other CAD software supporting lisp files.

After finishing installation process, you should load the provided menu files manually.

1. *Load the SurfMaster Menu following the steps below:*

- Start AutoCAD
- On the command line enter **MENULOAD** command

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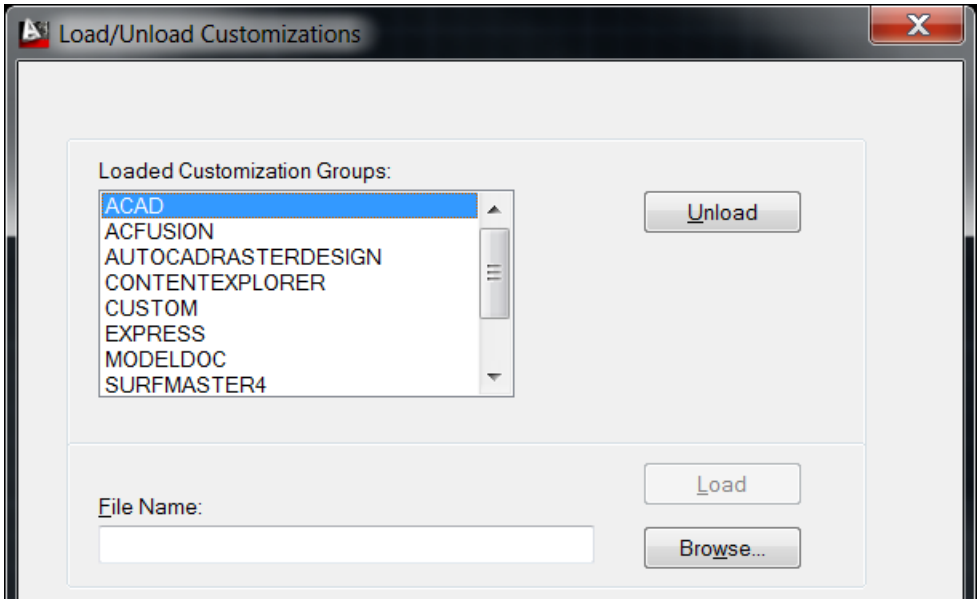
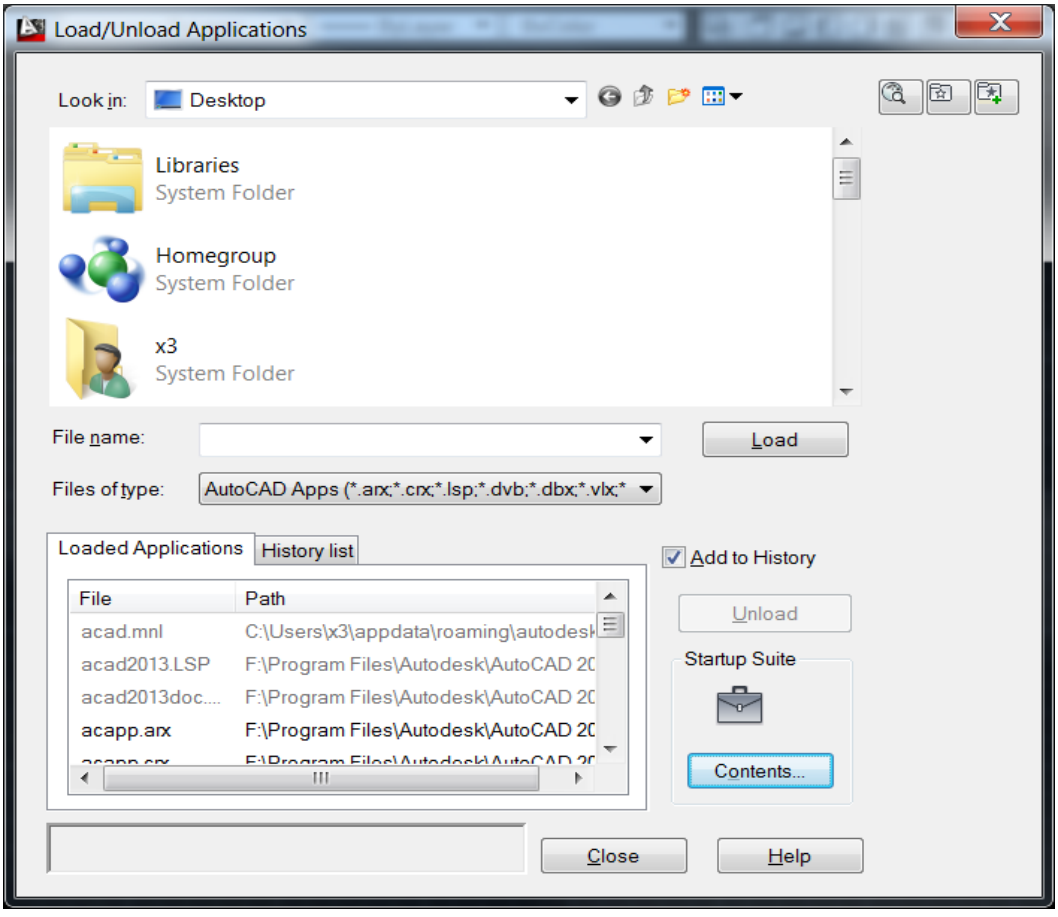


- Choose **Browse** button and select the **surfmaster.mnu** file from your installation folder and press the **Load** button.
- Repeat the steps for *zMeasure* if you have installed it (load the **zmeasure.mnu** file)
- Repeat the steps for *6Point Trilateration Positioner* if you have installed it (load trilpos.mnu file)

2. *Load the SurfMaster and / or zMeasure AutoLISP modules following the steps below:*



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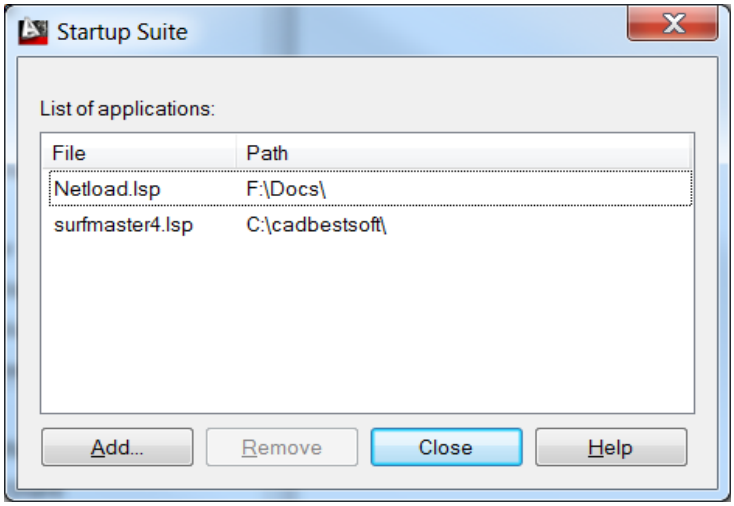
- From the **Main menu** select **Tools -> Load Applications (or use command "APPLOAD")**
- In the Load/Unload Applications dialog box navigate to **surfmaster4.lsp** file from your SurfMaster folder and press **Load** button. SurfMaster and all other AutoCAD applications that you have installed will be loaded in your current session.
- If you like SurfMaster (and zMeasure) to be loaded automatically each time when you start the host application, add the **surfmaster4.lsp** file in the **Startup Suite** (Contents**...** button) on the same dialog box.



- There is no need to repeat the process for zMeasure or Trilateration 6Point Positioner, because they are already included in **surfmaster4.lsp** automatically.

3. *AutoCAD 2014*

Note, that if you have AutoCAD version 2014 or later, you have to add the location of lisp modules (usually **c:\cadbestsoft**) to the "Trusted Locations" of AutoCAD options, to prevent asking for each lisp module during every loading session. In the AutoCAD tools menu, select **Options -> Files Tab -> Trusted Location,** click **Add…** and type in **c:\cadbestsoft** (or browse the installed folder) and press enter.

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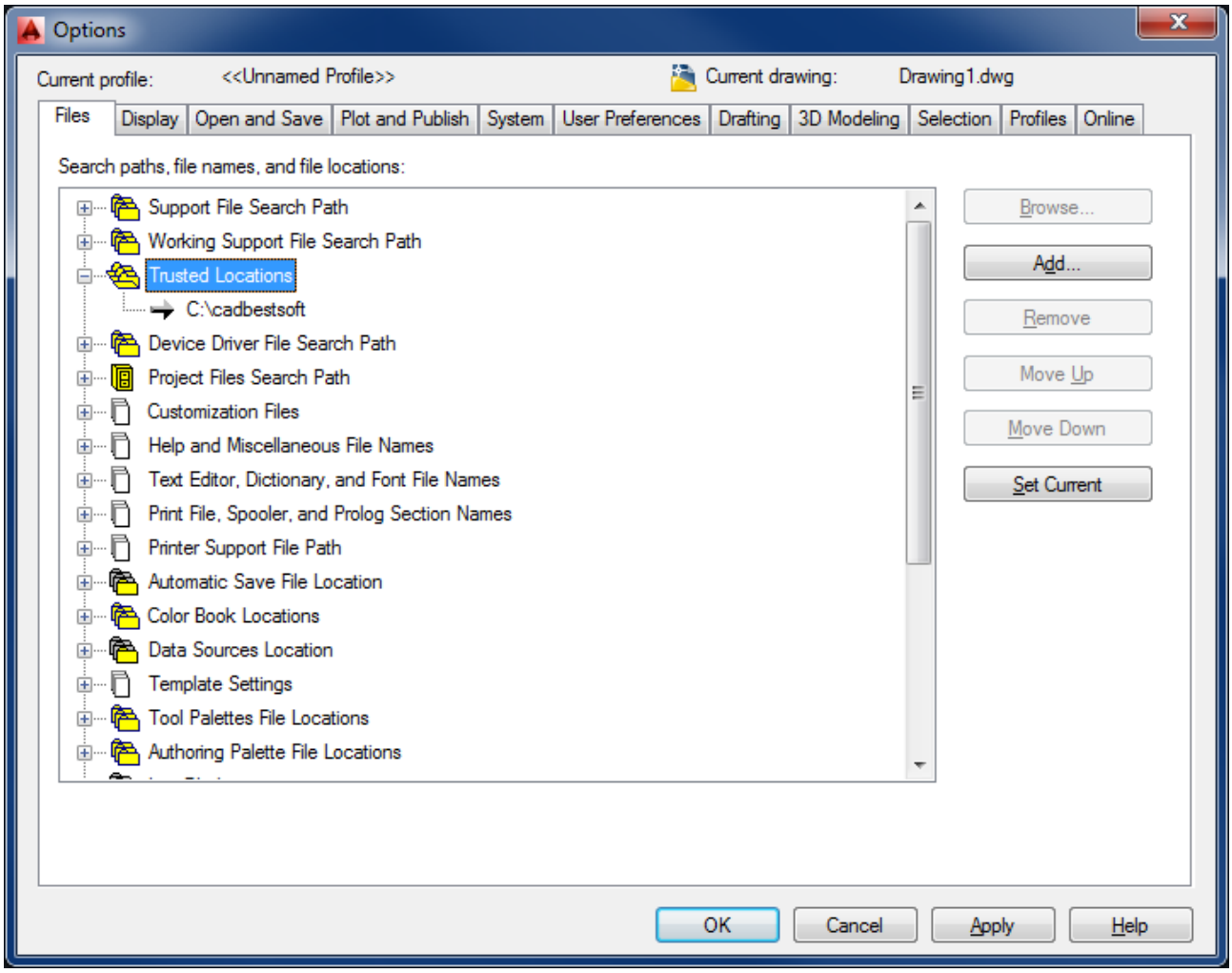

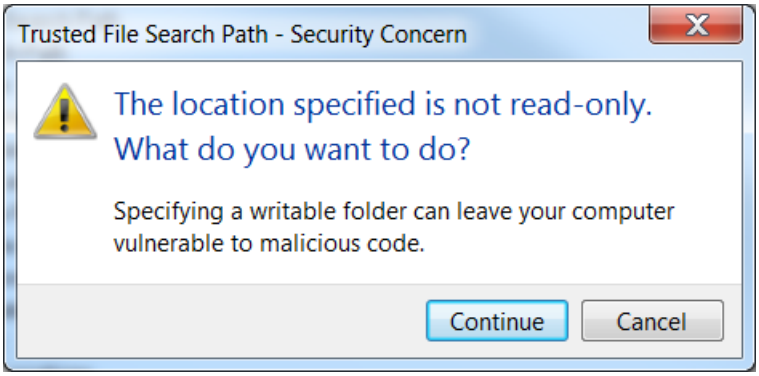
Trusted File Search Path - Security Concern
The location specified is not read-only.
What do you want to do?
Specifying a writable folder can leave your computer vulnerable to malicious code.
Continue
Cancel

Then click **Continue**, to confirm that the location is not read-only. That isn't an issue, it's just a Autodesk's security warning. So you can continue your work as usual.

4. *For more information or any troubleshooting don't hesitate to visit our website* http://cadbest.com *or mail us on* office@cadbest.com

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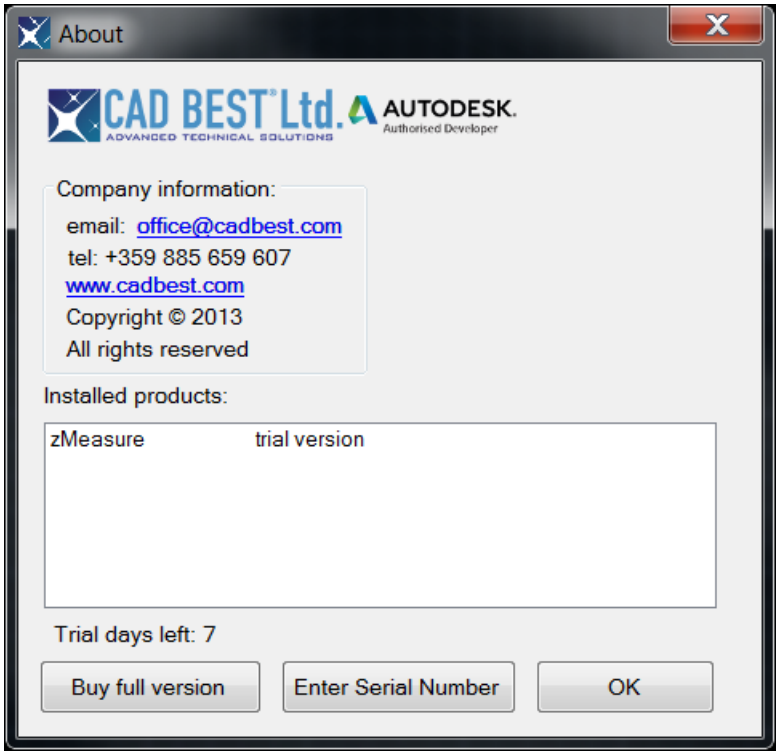
Activation

Activation is the process of verifying the serial number of a product, and licensing it to run on a specific computer. Activation cannot occur if the serial number is invalid, or if the computer is disconnected from the Internet. From each product menu in AutoCAD, or ζiTransform Help menu, you may choose About. If a product is not accessible due to ended trial period, you can register it from **Start Menu -> CAD BEST -> Register Products** shortcut or About.exe in your application directory.

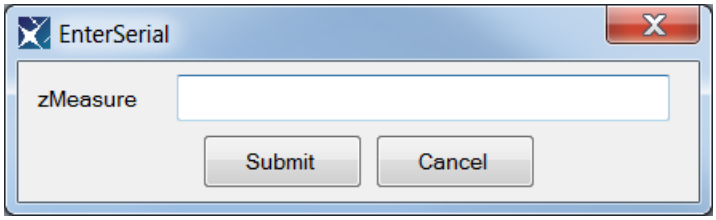
NOTE: If your SurfMaster or zMeasure installation got broken, you can always repair it through the setup executable, or **Start Menu -> CAD BEST -> Uninstall CAD BEST software** and then select **Modify** option.



This window contains information about installed product and their license status.

You have two options:

- ***Buy full version*** – Go to web site and purchase the products
- ***Enter Serial Number –*** from this button you can enter valid serial number and activate the product



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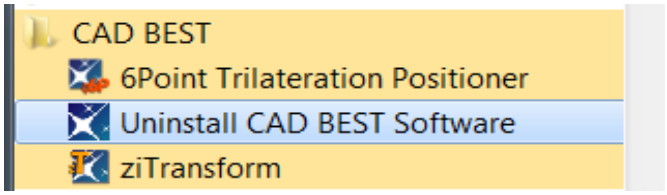
Uninstall

To uninstall several products or the entire suite, it is recommended that you use the Uninstaller, which you can launch from the list of products on your computer (Start menu -> All Programs -> CAD BEST).



Alternatively:

Windows 7 and 8: Control Panel -> Programs and features

Windows XP: Control Panel -> Add or Remove Programs

NOTE: You can also uninstall the product manually by deleting the Installation folder with its contents but that is not recommended.

Modify and repair

Launching setup executable after successful install, or the uninstaller, gives you also options for modify the software selection or repair the current installation. If trying the **modify option** and the setup executable is missing, you can download it again from our website. In the **Select Components** screen you can customize the current selection, to remove unnecessary components, or install additional ones.

Repair option gives you the opportunity to restore broken for some reason components of the products.

Again, these options require administrator privileges for the Windows user.

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